

91 **ARITHMETICK**

AND

73

MEASUREMENT,

Improv'd by

E X A M P L E S

AND

PLAIN DEMONSTRATIONS:

Wherein are laid down,

The different customary **PERCHES**, and
other **MEASURES**, used in the several
Parts of *Great Britain and Ireland*.

Suitable to all **ARTISTS**;

But more especially those who are employed in
BUILDING, GARDENING, SURVEYING
LAND, &c.

To which is added,

The Use of an **INSTRUMENT** (engrav'd on a Copper-Plate)
call'd a **TANGENT RULE**, for the taking any
given Distance within a Quarter of a Mile.

Illustrated with a great Variety of useful **CUTS**.

By **WILLIAM HALFPENNY**,
ARCHITECT and LAND SURVEYOR.

L O N D O N:

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(Price 2s. 6d.)

ARTIST'S PROOF

MEASUREMENT

18 1/2 x 11 1/2

PLATE 1

The object of this drawing is to show the general appearance of the machine, and to illustrate the principle of its operation.

It is to be understood that the several parts of the machine are not shown to scale, but are represented as they appear in reality.

For more complete information, reference is made to the accompanying description, and to the drawings of the machine, which are filed in the office of the Commissioners of Patents.



Witness my hand and seal, this 16th day of October, 1869.

By the Commissioners of Patents, J. H. MANNING, Secretary.





P R E F A C E.

THE great Regard I have for the Practical Parts of Mathematical Sciences, particularly that which relates to Building and Ground-work, put me on Thoughts to lay down such demonstrable Rules of Arithmetick, as are suitable to the several Calculations, Measurements and Valuations, that a Person, who has learned the four first Vulgar Rules only, and has a middling Capacity, may in a short Time comprehend all that is set forth in this Treatise, without the Help of any other Teacher; which, I presume, is sufficient to carry a Man through the greatest Undertaking of this Kind.

1. I begin with the Decimals of 10's, and shew the Working of that Rule in its four first different Parts, and compare them to those of Vulgar Arithmetick.

2. Three different Tables of Pounds, Shillings and Pence; shewing their several Decimals, with Examples how each Decimal is found.

3. Tables.

vi P R E F A C E.

3. *Tables of Perches according to the different Customs of Measurement in these Kingdoms; shewing the Feet they contain and their several Decimals, with Examples how they are found.*

4. *Tables of Tuns, and Loads of Timber; with those of Yards and Long Hundreds; with their several Decimals, and how they are found.*

5. *The Uses of all the foregoing Tables.*

6. *Tables for reducing Brick and Stone Walls to standard Thicknesses, according to the several Customs, with their proper Decimals and Uses.*

7. *Duodecimals; shewing their Declination, Addition, Subtraction and Multiplication, done by two Methods, viz. by plain Multiplication and Practice, with their several Uses in measuring Superficies and Solids, demonstrated by Inspection.*

8. *The Measurement of Angles, Circles and their Segments, with Ellipses; shewing the Differences between the mathematical Curve and the practical, demonstrated by Inspection.*

9. *To find the superficial Face of a Globe and its Frustums, with that of a Nick, &c. demonstrated by Inspection.*

10. *Rules for finding the superficial Faces of irregular and curved Figures, with Convex or Concave Dome, &c. of any Form, demonstrated by proper Examples.*

11. *To*

11. To measure an irregular Piece of Ground by the Chain only, and cast it into Acres, Roods and Perches; also to throw Links into Feet by a given Decimal, with other Rules relating thereto.

12. To measure and demonstrate, by Inspection, the solid Content of the Pyramid, with its Frustums both regular and irregular.

13. To measure and demonstrate, by Inspection, the solid Content of the Wedge and Reel in all their Shapes.

14. To measure and demonstrate, by Inspection, the solid Content of the Globe and its Frustums.

15. To demonstrate, by proper Examples, the Difference between the solid Content of a Cube, Cylinder and Globe of the same Diameter and Height, with given Decimals for the same.

16. To measure and demonstrate large irregular solid Bodies of Earth, &c. All which, I hope, will be found sufficient to perform the several Offices proposed in the former Part of this Preface.



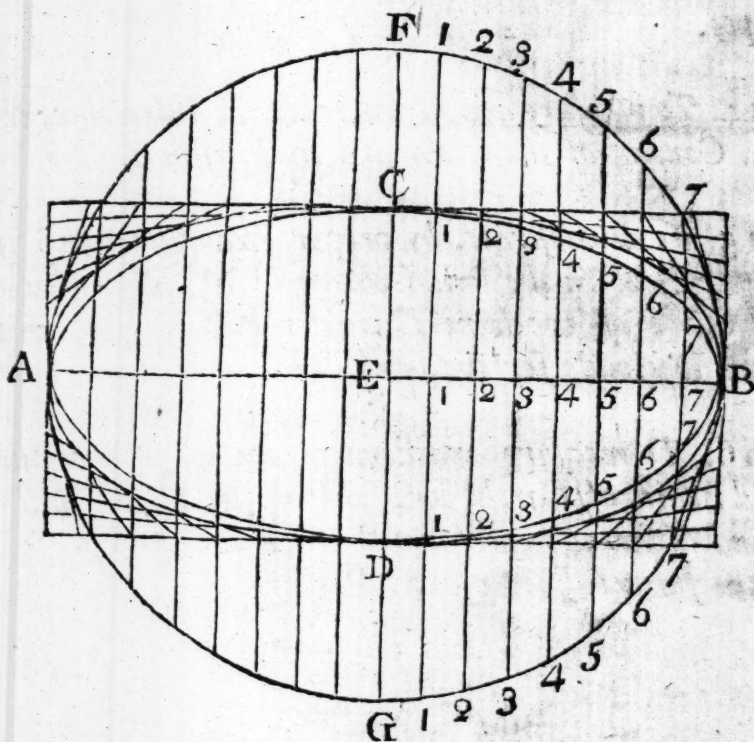
E R R A T A.

PAGE 47, *Line 5, 6 and 7, read thus, Parts in a Foot or Pence, or Parts in a Shilling, and diminishes by that Number.*

P. 80, l. 6, below the Sum for Quotient, r. Dividend.

P. 83, l. 11, for the Fourth, r. the 4. L. 19, for 185, r. 158.

P. 88, for the Demonstration of the Ovals (N^o. 129,) see the following Figure.



P. 118, l. 3, below (N^o. 167,) for or 6 Inches, r. of 6 Inches.

ARITH.





ARITHMETICK
MEASUREMENT,
IMPROV'D.

NUMERATION of DECIMALS.

THE Numbers of this Rule decrease to the Right, as Whole Numbers increase to the Left. See N^o. 1.

(N ^o . I.)		Hundreds of Millions
	9	Tens of Millions
	8	Millions
	7	Hundreds of Thousands
	6	Tens of Thousands
	5	Thousands
	4	Hundreds
	3	Tens
	2	Unit
	1.	Tenths of a Unit
	2	Hundredths of D ^o
	3	Thousandths of D ^o
	4	Ten thousandths of D ^o
	5	Hundred thousandths of D ^o
	6	Millions of D ^o
	7	Ten Millions of D ^o
	8	Hundred Millions of D ^o
	9	

$\angle$ WHOLE NUMBERS $\angle$ DECIMALS. $\angle$

Observe to distinguish the Decimals from Whole Numbers by a Dot, as in this Example.

B

The

2 ARITHMETICK, &c. Improv'd.

The Unit is called the Denominator, because it is supposed to be any one Thing; as Farthing, Penny, Shilling, Pound; Inch, Foot, Yard, Perch, &c.

Suppose the Denominator or Unit to be an Inch, take two Whole Numbers and one Decimal thus, 21.2 is 21 Inches and $\frac{2}{10}$ of an Inch. Again, take two Whole Numbers and the second Place of Decimals 21.03, which is 21 Inches and $\frac{3}{100}$ of an Inch; and so on; always observing to keep the Decimals in their proper Stations by adding Cyphers as their Place requires: For Example, .0005 is $\frac{5}{10000}$ of an Inch. Again, .0000608 is $\frac{608}{10000000}$ of an Inch; which is shew'd more plain in the following Examples:

ADDITION of DECIMALS.

Suppose the Denominator to be a Foot, observe to place the several Decimals in their proper Stations. Thus,

$$\begin{array}{r}
 .4 \\
 .0064 \\
 .0273 \\
 .05 \\
 .75 \\
 (N^o. 2.) \quad .0000896 \\
 .9741 \\
 .00000803 \\
 .00280 \\
 \hline
 2.21069763 \\
 \hline
 \end{array}$$

Their Sum is 2 Feet and $\frac{21069763}{10000000}$ of a Foot.

N. B.



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N. B. These are added in the same Manner, as Whole Numbers, only with this Difference, that all the Tens which are carried to the Left of the Dots, are Whole Numbers.

ADDITION of MIXT NUMBERS.

Suppose the Denominator to be a Gallon.

$$\begin{array}{r}
 10.075 \\
 4.007 \\
 162.5 \\
 \text{(N^o. 3.)} \quad 18.93 \\
 \quad .786 \\
 \quad 8.21 \\
 \quad .0005 \\
 \hline
 204.5085 \\
 \hline
 \end{array}$$

Their Sum is 204 Gallons and $\frac{5085}{10000}$ of a Gallon.

SUBTRACTION of DECIMALS.

It is required to substract .0025 from .5, a Yard superficial being the Denominator. The latter Decimal being of the greatest Value, must be placed uppermost, altho' it does not contain so many Places of Figures as the former; in this Case, it is not amiss to add Cyphers to the Right in the uppermost Line; but it must be observed, that Cyphers, to the Right of a Decimal, do not increase its Value; no more than Cyphers to the Left of Whole Numbers increase their Sum.

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$$\begin{array}{r}
 \text{(N}^\circ\text{. 4.)} \quad .5000 \\
 \quad \quad .0025 \\
 \hline
 \quad \quad .4975 \text{ Remains}
 \end{array}$$

N. B. This is worked in the same Manner, as Whole Numbers, except adding Cyphers to the upper Line.

SUBTRACTION of MIXT NUMBERS.

It is required to subtract .864 from 635, a Foot being the Denominator. Place the Whole Numbers in the uppermost Line, and add Cyphers in the Place of Decimals.

$$\begin{array}{r}
 \text{(N}^\circ\text{. 5.)} \quad 635.000 \\
 \quad \quad .864 \\
 \hline
 \quad .634.136 \text{ Remains}
 \end{array}$$

It is required to subtract 42.926 from 68.247, a Shilling being the Denominator.

$$\begin{array}{r}
 \text{(N}^\circ\text{. 6.)} \quad 68.247 \\
 \quad \quad 42.926 \\
 \hline
 \quad 25.321 \text{ Remains}
 \end{array}$$

MULTIPLICATION of DECIMALS.

Proceed as in Whole Numbers, but observe this General Rule, to separate so many Figures (to the Right of the Product by a Dot) as there are Decimals in the Multiplicand and Multiplier ;

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erator; and those to the Left are Whole Numbers. This Rule must be observed in all Multiplication of Decimals, except one Case, which I shall shew hereafter. To multiply 2.5 by 2.5, a Foot being the Denominator.

2.5 Multiplicand
2.5 Multiplier

(N^o. 7.)

125
50

6.25 Product

To multiply 27.75 by 15, an Inch being the Denominator.

27.75 Multiplicand
15 Multiplier

(N^o. 8.)

13875
2775

416.25 Product

To multiply 724.75 by 27.25, a Perch being the Denominator.

(N^o. 9.)

724.75 Multiplicand
27.25 Multiplier

3623 75
14495 0
507325
144950

19749.43 75 Product

To

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To multiply 452 by .743, an Inch being the Denominator.

$$\begin{array}{r} 452 \text{ Multiplicand} \\ .743 \text{ Multiplier} \\ \hline \end{array}$$

(N^o. 10.)

$$\begin{array}{r} 1356 \\ 1808 \\ 3164 \\ \hline 335.836 \text{ Product} \end{array}$$

To multiply .0079 by .5, a Cube-foot being the Denominator.

$$\begin{array}{r} .0079 \text{ Multiplicand} \\ .5 \text{ Multiplier} \\ \hline .00395 \text{ Product} \end{array}$$

(N^o. 11.)

Observe, in the Multiplication of this Sum, it produces but four Places of Decimals, which is one less than is contained in the Multiplicand and Multiplier, because there is nothing carried from the Place of Tenths. In this and the like Cases, there must be another Cypher added to the Left of the Product, as in this Example; otherwise it will be ten Times more than its real Value. This never happens in mixt Numbers, because they naturally produce as many Figures, as there are Decimals in the Multiplier and Multiplier; as may be seen by the following Example.

To multiply 1.00095 by .6, a Gallon being the Denominator.

(N^o. 12.)

(N^o. 12.)

1.00095	Multiplicand
.6	Multiplicator
.600570	
	Product

DIVISION of DECIMALS.

The only Difference between this Rule and that of Whole Numbes, is only to distinguish the one from the other in the Quotient.

To divide a lesser Number by a greater, which must consequently produce no other than Decimals in the Quotient. Let it be twenty Shillings between eighty Men, as 20 cannot be divided by 80, add Cyphers to the Dividend, more or less, as Occasion requires.

Dividend

Divisor	80	20.00(.25	Quotient
		160	
		400	
		400	
		0	

(N^o. 13.)

Each Man's Share is $1\frac{2}{5}$ of a Shilling.

To divide 99 Feet by 16.5, add Cyphers to the Dividend, as in the foregoing Example; and observe this General Rule, to work so many Decimal Places of the Dividend, as there are Decimals in the Divisor, and their Quotient is Whole Numbers; then make a Dot, and work the Remainder (if any) which are Decimals. See the following Examples.

Divisor

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$$\begin{array}{r}
 \text{Dividend} \\
 \text{Divisor } 16.5 \overline{) 99.00} (6 \text{ Quotient} \\
 \underline{990} \\
 000
 \end{array}$$

(N^o. 14.)

N.B. This Sum admits of no Remainder, therefore the Quotient is a Whole Number.

To divide 478 Feet, a Whole Number, by 16.5 a Mix'd Number. Add Cyphers to the Dividend, as before hinted.

$$\begin{array}{r}
 \text{Dividend} \\
 \text{Divisor } 16.5 \overline{) 478.0000} (28.969 \text{ Quotient} \\
 \underline{330} \\
 1480 \\
 \underline{1320} \\
 1600 \text{ bring down the second} \\
 1485 \text{ Cypher, and make a} \\
 \underline{\hspace{1cm}} \text{ Dot in the Quotient.} \\
 1150 \\
 \underline{990} \\
 1600 \\
 \underline{1485} \\
 115
 \end{array}$$

(N^o. 15.)

N.B. This Sum may be work'd to Infinity, by adding a Cypher to every Period, but two or three Places of Decimals are sufficient for any practical Business, the Remainder being of no material Value. Again, it may not be amiss for Learners, to work the foregoing Sum, &c. thus,

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Add no more Cyphers to the Dividend, than there are Decimals in the Divisor, the Quotient is Whole Numbers; make a Dot to distinguish them, then add a Cypher to the Remainder (if any) and so on, to every new Period.

To divide a Mix'd NUMBER, by a Mix'd NUMBER.

	Dividend	
Divisor	2.75)62.9928(22.906	Quotient
	550	
	799	
(N ^o . 16.)	550	
	2492	Make a Dot in the
	2475	Quotient
	1780	Add a Cypher to
	1650	the Quotient, and
		one to the Period.
	130	

To divide 946527 superficial Feet into Statute Perches of Land or *London* Rods of Brick-work. The Perch or Rod contains 272.25 superficial Feet.

Coddington Divisor

10 ARITHMETICK, &c. Improv'd.

Divisor Dividend Quotient

272.25)946527.00(3476.683

81675

129777

108900

208770

(N^o. 17.)

190575

181950

163350

186000

163350

Make a Dot in the
Quotient, and add
a Cypher.

226500 Add a Cypher

217800

87000 Add a Cypher

81675

5325 Remains.

To divide WHOLE NUMBERS by
DECIMALS.

Dividend

Divisor .25)347.00(1388 Quotient

25

97

75

(N^o. 18.)

220

200

200

200

0

N. B.

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N. B. As there is no Remainder in this Sum, the Quotient is all whole Numbers.

To divide 647239 by .750. See the following Example.

Divisor	Dividend	Quotient	
.750	647239.000	(862985.33	Multiplicand
6000		.750	Multiplicator

4723	4314926650	
4500	604089731	
2239	250	Remainder
1500	647239.00000	Proof

7390
6750

6400
6000

(N^o. 19.)

4000
3750

2500 Make a Dot in the Quo-
2250 tient, and add a Cypher.

2500 Add a Cypher
2250

250 - Remains.

N. B. Learners may not immediately perceive, why there should be two Cyphers more in the

C 2

Proof

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Proof than there is in the Dividend: Answer, because there is two added (in carrying on the Work) to give the Decimals of the Remainders: All Kinds of Division may be prov'd, by multiplying the Dividend by the Divisor, and adding the Remainder.

To find the Decimal Number of any Part or Parts of a Denominator, observe this General Rule: First, consider how many such Parts are contained therein; then work by the Rule of Three; say, as so many Parts in the Denominator is to 100, so are the Parts given, to the Decimal Number requir'd. Let the Denominator be a Foot, and the Decimal Number of 9 Inches be requir'd; say, as

In. Parts Inches

$$12 = 100 = 9$$

$$\begin{array}{r} 9 \\ 12 \overline{) 900} (.75 \quad \text{Decimal requir'd} \\ \underline{84} \quad 12 \end{array}$$

(N^o. 20.)

$$\begin{array}{r} 60 \quad 150 \\ 60 \quad 75 \\ \hline \end{array}$$

$$(0) .900 \quad \text{Proof}$$

N. B. This answers the same, to the Pence in a Shilling; and observe, that in the same Manner as this Example is prov'd, is the General Rule for finding the Value of any Decimal; as I shall shew hereafter: But there is one Caution may be proper to be given, which is the finding the Decimal of Number 1: Observe this General Rule, Add a Cypher to the Left of the Quotient,

Quotient, otherwise it will appear to be 10 Times more than its real Value. Suppose 12 be the Denominator. See the following Examples:

$$12 = 100 = 1$$

I

(N^o. 21.)

$$\begin{array}{r} 12 \overline{) 100.83} \\ \underline{96} \\ 40 \\ \underline{36} \\ 4 \end{array}$$

N. B. This Example proves (N^o. 21.) to be 10 Times more than its real Value, because it's impossible that one of 12, should be equal to 83 of 100. This is caused, by Figure 1 admitting no Figures to be carried to the Left, which is the Case of (N^o. 11.) therefore a Cypher must be added to the Left of the Quotient, and it will give the Decimal thus, .083; and so of Number 1, in all Denominations: Or, it may be work'd thus.

$$12 = 100 = 01$$

01

100

000

(N^o. 22.)

$$\begin{array}{r} 12 \overline{) 0100.083} \\ \underline{96} \\ 40 \\ \underline{36} \\ 4 \end{array}$$

The

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The following Table shews the Decimal Numbers of all the Inches in a Foot, or Pence in a Shilling.

Foot or Shilling	Pence or Inches	Decimals
	12	100
	11	.916
	10	.833
	9	.75
(N ^o . 23.)	8	.666
	7	.583
	6 is	.5
	5	.416
	4	.333
	3	.25
	2	.166
	1	.083

To find the Decimal of any Number of Quarters in an Inch, or Farthings in a Penny, let two Quarters be given.

(N^o. 24.)

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The following Table shews the Decimal Sum of all the Numbers of Shillings in a Pound

(N^o. 24.)
$$\begin{array}{r} 4 \overline{)200} \end{array} \begin{array}{l} .5 \\ 20 \\ \hline 0 \end{array} \text{Decimal}$$

The following Table shews the Decimal Numbers of all the Quarters in an Inch, or Farthings in a Penny.

Inch or Penny	Quarters or Farthings		Decimals
	4		100
	3		.75
	2	is	.5
	1		.25

To find the Decimal Sum of any Number of Shillings in a Pound, let 13 Shillings be given.

(N^o. 26.)
$$\begin{array}{r} 20 \overline{)1300} \end{array} \begin{array}{l} .65 \\ 120 \\ 100 \\ \hline 100 \\ \hline 0 \end{array} \text{Decimal}$$

The

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The following Table shews the several Decimal Sums of all the Numbers of Shillings in a Pound.

A Pound



(N^o. 27.)

Shillings Decimal

20	100
19	.95
18	.9
17	.85
16	.8
15	.75
14	.7
13	.65
12	.6
11	.55
10	is .5
9	.45
8	.4
7	.35
6	.3
5	.25
4	.2
3	.15
2	.1
1	.05

A Perch of Brick, or Stone-Wall, in many Places of *Great-Britain* and *Ireland*, contains 16.5 superficial Feet; to find the Decimal of any Number of Feet contain'd therein: Let 12 Feet be given.

16.5

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$$16.5 = 100 = 12$$

$$\begin{array}{r} 12 \\ \hline 200 \end{array}$$

(N^o. 28.)

$$16.5)1200.0(.727 \text{ Decimal}$$

$$\begin{array}{r} 1155 \\ \hline \end{array}$$

$$450$$

$$\begin{array}{r} 330 \\ \hline \end{array}$$

$$1200$$

Add a Cypher

$$\begin{array}{r} 1155 \\ \hline \end{array}$$

$$45$$

The following Table shews the several Decimal Sums of any Number of Feet in a Perch of 16.5 superficial Feet.

Feet Decimals

A Perch

16.5		100
16		.969
15		.909
14		.848
13		.787
12		.727
11		.666
10		.606
9		.545
8		.484
7		.424
6		.363
5		.303
4		.242
3		.181
2		.121
1		.06

D

In

(N^o. 29.)

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In some Places of *Great Britain* 18 superficial Feet is a Perch of Brick or Stone-Wall. To find the several Decimals of any Number of Feet contained therein: Let 5 Feet be given.

$$18 = 100 = 5$$

5

$$18 \overline{) 500} (.277$$

36

(N^o. 30.)

140

126

140

Add a Cypher

126

14

The following Table shews the several Decimal Sums of every Number of Feet, contained in a Perch of 18 superficial Feet.

A Perch

Feet Decimals

18		100
17		.944
16		.888
15		.833
14		.777
13		.722
12		.666
11		.611
10		.555

(N^o. 31.)

A Perch

Feet	Decimals
9	.5
8	.444
7	.388
6	.333
5	.277
4	.222
3	.166
2	.111
1	.055

In many Places, especially in some Parts of the North of *England*, and West of *Ireland*, a Perch of Brick or Stone-Wall, is 21 superficial Feet, and is called Plantation Measure. To find the several Decimals of every Number of Feet contained therein: Let 8 Feet be given.

$$21 = 100 = 8$$

(N^o. 32.)

$$\begin{array}{r}
 21 \overline{) 800} (.38 \text{ Decimal} \\
 \underline{63} \\
 170 \\
 \underline{168} \\
 2
 \end{array}$$

The following Table shews the Decimal Sums of the several Feet, contained in a Perch of 21 superficial Feet.

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	Feet	Decimals
A Perch	21	100
	20	.95
	19	.9
	18	.85
	17	.8
	16	.76
	15	.71
	14	.66
	13	.61
(N ^o . 33.)	12	.57
	11	.52
	10	.47
	9	.42
	8	.38
	7	.33
	6	.28
	5	.23
	4	.19
	3	.14
	2	.09
	1	.04

A *London* Perch or Rod of Brick-Wall is 16.5 Feet square, equal to a Statute Perch of Land, which contains 272.25 superficial Feet.

To

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To find the several Decimals of every Number of Feet contain'd therein, let 105 Feet be given.

$$272.25 = 100 = 105$$

105

—

500

1000

—

$$272.25)10500.00(.385 \text{ Decimal}$$

8167 5

—

2332 50

2178 00

—

1545 00

Add a Cypher

(N^o. 34.)

1361 25

—

18375

Remains

The following Table shews the Decimal Sums of the several Feet contain'd in a Statute Perch of Land, or *London* Rod of Brick-Wall.

Feet	Dls.	Feet	Dls.	Feet	Dls.
Rod 272.25	100	261	.958	249	.914
272	.999	260	.955	248	.91
271	.995	259	.951	247	.907
270	.991	258	.947	246	.903
269	.988	257	.943	245	.899
(N ^o . 35.) 268 is	.984	256 is	.94	244 is	.896
267	.98	255	.936	243	.892
266	.977	254	.932	242	.888
265	.973	253	.929	241	.885
264	.969	252	.925	240	.881
263	.966	251	.921	239	.877
262 is	.962	250	.918	238	.874
					.237

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Feet	Dls.	Feet	Dls.	Feet	Dls.
237	.87	194	.712	151	.554
236	.866	193	.708	150	.55
235	.863	192	.705	149	.547
234	.859	191	.701	148	.543
233	.855	190	.697	147	.539
232	.852	189	.694	146	.536
231	.848	188	.69	145	.532
230	.844	187	.686	144	.528
229	.84	186	.683	143	.525
228	.837	185	.679	142	.521
227	.833	184	.675	141	.517
226	.83	183	.672	140	.514
225	.826	182	.668	139	.51
224	.822	181	.664	138	.506
223	.819	180	.661	137	.503
222	.815	179	.657	136	.499
221	.811	178	.653	135	.495
220	.808	177	.65	134	.492
219	.804	176	.646	133	.488
218	.8	175	.642	132	.484
217	.797	174	.639	131	.481
(N°.35.) 216 is	.793	173 is	.635	130 is	.477
215	.789	172	.631	129	.473
214	.786	171	.628	128	.47
213	.782	170	.624	127	.466
212	.778	169	.62	126	.462
211	.775	168	.617	125	.459
210	.771	167	.613	124	.455
209	.767	166	.609	123	.451
208	.764	165	.606	122	.448
207	.76	164	.602	121	.444
206	.756	163	.598	120	.44
205	.752	162	.595	119	.437
204	.749	161	.591	118	.433
203	.745	160	.587	117	.429
202	.741	159	.583	116	.426
201	.738	158	.58	115	.422
200	.734	157	.576	114	.418
199	.73	156	.573	113	.415
198	.727	155	.569	112	.411
197	.723	154	.565	111	.407
196	.719	153	.561	110	.404
195	.716	152	.558	109	.4
					108

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Feet	Dls.	Feet	Dls.	Feet	Dls.
108	.396	72	.264	36	.132
107	.393	71	.26	35	.128
106	.389	70	.257	34	.124
105	.385	69	.253	33	.121
104	.382	68	.249	32	.117
103	.378	67	.246	31	.113
102	.374	66	.242	30	.11
101	.37	65	.238	29	.106
100	.367	64	.235	28	.102
99	.363	63	.231	27	.099
98	.359	62	.227	26	.095
97	.356	61	.224	25	.091
96	.352	60	.22	24	.088
95	.348	59	.216	23	.084
94	.345	58	.213	22	.08
93	.341	57	.209	21	.077
92	.337	56	.205	20	.073
(N ^o .35.) 91 is	.334	55 is	.202	19 is	.069
90	.33	54	.198	18	.066
89	.326	53	.194	17	.062
88	.323	52	.191	16	.058
87	.319	51	.187	15	.055
86	.315	50	.183	14	.051
85	.312	49	.179	13	.047
84	.308	48	.176	12	.044
83	.304	47	.172	11	.04
82	.301	46	.168	10	.036
81	.297	45	.165	9	.033
80	.293	44	.161	8	.029
79	.29	43	.157	7	.025
78	.286	42	.154	6	.022
77	.282	41	.15	5	.018
76	.279	40	.146	4	.014
75	.275	39	.143	3	.011
74	.271	38	.139	2	.007
73	.268	37	.135	1	.003

To

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To find the several Decimals of any Number of Feet contained in a superficial Yard, let 7 Feet be given.

$$\begin{array}{r}
 9 = 100 = 7 \\
 \underline{7} \\
 9)700(.777 \text{ Decimal} \\
 \underline{63} \\
 70 \\
 \underline{63} \\
 70 \text{ Add a Cypher} \\
 \underline{63} \\
 7
 \end{array}$$

(N^o. 36.)

The following Table shews the Decimal Sums of the several Feet contained in a superficial Yard.

A Yard

(N^o. 37.)

Feet	Decimals
9	100
8	.888
7	.777
6	.666
5	is .555
4	.444
3	.333
2	.222
1	.111

In most Places of *Great Britain*, and *Ireland*,
(except in and about *London*) Timber is bought
and

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and sold by what is called a Tun, which is 40 Cube Feet. To find the several Decimals of any Number of Feet contained therein, let 13 Feet be given.

$$40 = 100 = 13$$

13

300

100

$$40)1300(.325$$

Decimal

120

(N^o. 38.)

100

80

200

Add a Cypher

200

0

The following Table shews the Decimal Sums of the several Feet contain'd in a Tun of Timber.

	Feet	Decimals	Feet	Decimals
A Tun	40	100	31	.775
	39	.975	30	.75
	38	.95	29	.725
	37	.925	28	.7
(N ^o . 39.)	36 is	.9	27 is	.675
	35	.875	26	.65
	34	.85	25	.625
	33	.825	24	.6
	32	.8	23	.575

E

22

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Feet	Decimals	Feet	Decimals
22	.55	11	.275
21	.525	10	.25
20	.5	9	.225
19	.475	8	.2
18	.45	7	.175
(N ^o . 39.) 17	is .425	6	is .15
16	.4	5	.125
15	.375	4	.1
14	.35	3	.075
13	.325	2	.05
12	.3	1	.025

In and about *London*, Timber is bought and sold by the Load, which contains 50 Cube Feet: To find the several Decimals of any Number of Feet contained therein, let 32 Feet be given.

$$50 = 100 = 32$$

32

(N^o. 40.)

200

300

50)3200(.64

Decimal

300

200

200

0

The following Table shews the Decimal Sums of the several Feet contain'd in a Load of Cube Timber.

A

Artificial Brick, &c. Improved. 327

Feet	Dls.	W	Feet	Dls.	Feet	Dls.
A Load 30	1.00	M	33	.66	16	.32
49	.98		32	.64	15	.30
48	.96		31	.62	14	.28
47	.94		30	.60	13	.26
46	.92		29	.58	12	.24
45	.90		28	.56	11	.22
44	.88		27	.54	10	.20
43	.86		26	.52	9	.18
(N ^o . 41.) 42 is	.84		25 is	.50	8 is	.16
41	.82		24	.48	7	.14
40	.80		23	.46	6	.12
39	.78		22	.44	5	.10
38	.76		21	.42	4	.08
37	.74		20	.40	3	.06
36	.72		19	.38	2	.04
35	.70		18	.36	1	.02
34	.68		17	.34		

The Use of the foregoing Table is to find the Value of the several Parts of a Perch, Yard, Tun, Load, &c. for Example: Suppose a Perch of Brick-Wall of 16.5 superficial Feet cost 7s. 4d. What is the Value of 17 Perch and 7 Feet? Look in N^o. 27 for the Decimal of 4d. and the Money will stand thus, 7.333; then look in (N^o. 29.) for the Decimal of 7 Feet, and the Work will stand thus, 17.424. See the following Example.

Example. Suppose a Perch of Brick-Wall of 16.5 superficial Feet cost 7s. 4d. What is the Value of 17 Perch and 7 Feet? Look in N^o. 27 for the Decimal of 4d. and the Money will stand thus, 7.333; then look in (N^o. 29.) for the Decimal of 7 Feet, and the Work will stand thus, 17.424. See the following Example.

Example. Suppose a Perch of Brick-Wall of 16.5 superficial Feet cost 7s. 4d. What is the Value of 17 Perch and 7 Feet? Look in N^o. 27 for the Decimal of 4d. and the Money will stand thus, 7.333; then look in (N^o. 29.) for the Decimal of 7 Feet, and the Work will stand thus, 17.424. See the following Example.

28. Arithmetic, &c. Improv'd.

	17.424	Work
	7.333	Money per Perch
(N ^o . 42.)	52 272	
	522 72	
	5227 2	
	121 96 8	
Shillings	127).770192	
	12	Pence in a Shilling
	1 540384	
	7 70192	
Pence	9).242304	
	4	Farthings in a Penny
	.969216	

The whole Value appears to be 127s. 9d. (and almost a Farthing remains) which is 6l. 7s. 9d. Throw Shillings into Pounds, by cutting off the Unit, and halving the Figures to the Left, thus,

	s.	d.	
(N ^o . 43.)	12	7	9
	6	3	4
	6	7	9
	The Sums of N ^o . 40.		

Again, let 137s. be given, cut off the Unit and halve the 13; say the half of 13 is 6 and 1 remains equal to 10s. which must be carried to the Place of Shillings, the Sum will stand thus, 6l. 17s. 0d. (N^o. 44.)

13	7		Shillings
6	3	d.	
6	17	0	Sum in Pounds.

If

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If it should be ask'd why this Rule throws Shillings into Pounds? Answer, Because all the Figures to the Left of the Place of Units are Tens, consequently half their Sum must be Twenties, except the remaining 1, which is 10s. and must be carried to its proper Place.

A Perch of 16.5 Feet being the Denominator: To know the Value of 13 Feet at 7s. 3d. per Perch, look in (N^o. 23.) for the Decimal of 3d. and the Money will stand thus, 7.25; then look in (N^o. 29.) for the Decimal of 13 Feet, and the Work will stand thus, .787

	7.25	Money
	.787	Work

	5075	
	5800	
	5075	
Shillings	570575	

12 Pence in a Shilling

(N^o. 45.)

	121150	
	60575	
Pence	7.26900	

4 Farthings in a Penny

Farthings	1.07600
-----------	---------

The Value of 13 Feet appears to be 5 Shillings and 7 Pence Farthing.

To know the Value of 75 Yards, 5 Feet, of Wainscot at 4s. 8d. per Yard. Look in (N^o. 37.)

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(N^o. 37.) for the Decimal of 5 Feet, and the Work will stand thus, 75.555. Then look in (N^o. 23.) for the Decimal of 8 d. and the Money will stand thus, 4.666

75.555 Work
4.666 Money

(N^o. 46.) 453 330
4 533 30
45 333 0
302 220

Shillings 352.539 630
12 Pence in a Shilling

1 079 260
5 396 30

Pence 6.475 560
4 Farthings in a Penny

Farthings 1.902 240

s. d.
The Value appears to be 35 | 2 6 $\frac{1}{4}$
(N^o. 47.) or £. 17-12 6 $\frac{1}{2}$

To know the Value of 764 Yards, and 7 Feet of Plaistering at 3 d $\frac{1}{2}$ per Yard. Look in (N^o. 37.) for the Decimal of 7 Feet, the Work will stand thus, 764 777: Then look in (N^o. 25.) for the Decimal of a $\frac{1}{2}$, and the Money will stand thus, 3.5

(N^o. 48.)

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$$\begin{array}{r}
 764.777 \text{ Work} \\
 \underline{3.5 \text{ Money}} \\
 (N^{\circ}. 48.) \quad 382 \ 3 \ 88 \ 5 \\
 \underline{2294 \ 3 \ 31} \\
 \text{Pence} \quad 2676.7 \ 19 \ 5 \\
 \underline{4} \text{ Farthings in a Penny} \\
 \text{Farthings} \quad 2.8 \ 78 \ 0
 \end{array}$$

The Sum appears to be 2676 — $\frac{1}{2}$

(N^o. 49.)

$$\begin{array}{r}
 \text{or} \quad 22 \ 1 \ 3 \ 0 \ \frac{1}{2} \\
 \text{or} \quad \pounds. \ 11 \ 3 \ 0 \ \frac{1}{2}
 \end{array}$$

To know the Value of 42 *London Rod*, and 137 Feet of Brick-Wall, at 6*l*. 14*s*. *per Rod*, look in (N^o. 35.) for the Decimal of 137 Feet, and the Work will stand thus, 42.503; then look in (N^o. 27.) for the Decimal of 14*s*. and the Money will stand thus, 6.7.

$$\begin{array}{r}
 42.503 \text{ Work} \\
 \underline{6.7 \text{ Money}} \\
 29 \ 7 \ 52 \ 1 \\
 \underline{2550 \ 18} \\
 \text{Pounds} \quad 284.7 \ 70 \ 1 \\
 \underline{20} \text{ Shillings in a Pound} \\
 \text{Shillings} \quad 15.4 \ 02 \ 0 \\
 \underline{12} \text{ Pence in a Shilling} \\
 (N^{\circ}. 50.) \quad 8 \ 04 \ 0 \\
 \underline{40 \ 20} \\
 \text{Pence} \quad 4.8 \ 24 \ 0 \\
 \underline{4} \text{ Farthings in a Penny} \\
 \text{Farthings} \quad 3.2 \ 96 \ 0
 \end{array}$$

The

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The Value appears to be 284*l.* 15*s.* 4*d.*¹/₄.

N. B. By applying to the proper Tables, the several Measurements of a Building may be cast up, and the Value of the minutest Part found; but, observe, there is no Table in this Work for the Measure, call'd a Square, which contains 100 superficial Feet, because every Number of Feet contain'd therein, are naturally so many Decimal Parts of the Denominator.

To know the Value of 15 Square 63 Feet of Roofing at 2*l.* 9*s.* per Square: The Feet being Decimals causes the Work to stand thus, 15.63; then look into (N^o. 27.) for the Decimal of 9*s.* and the Money will stand thus, 2.45.

	15.63	Work
	2.45	Money
	78 15	
	6 25 2	
	31 26	
Pounds	38.29 35	
	20	Shillings in a Pound
Shillings	5.87 00	
	12	Pence in a Shilling
(N ^o . 51.)	1 74 00	
	8 70 0	
Pence	10.44 00	
	4	Farthings in a Penny
Farthings	1.76 00	The

The Value appears to be 38*l*. 5*s*. 10*d*. $\frac{1}{4}$.

N. B. So work as Decimals, every Number of Feet contained in a Square.

The general Rule to find the Value in Measure, and Money of any Decimal (as is hinted in *N. B.* (N^o. 20.) is as follows: First, to consider what Parts the Denominator is commonly divided into, as a Pound into Shillings, a Shilling into Pence, a Penny into Farthings; a Perch Square or Yard into Feet, and a Foot, Gallon or Bushel into Inches: These are the general Parts they are made up of in the common Course of Business; but a Person may throw them into any other Parts as he shall think proper, which does not alter the Nature of working the Numbers.

Suppose .5 of a Wine Gallon be given; to know how many Cube Inches it contains, Multiply the Number of Inches in a Gallon (which is 231) by the Decimal, the Content is the Inches required.

	231	Inches in a Gallon
N ^o . 52.)	.5	Decimal
	115.5	Inches required

Suppose a Gallon of Wine cost 8*s*. 4*d*. What is the Value of .5 of a Gallon? Look in (N^o. 23.) for the Decimal of 4*d*. and the Price of the Gallon of Wine stands thus, 8.333, which multiply by the given Decimal, the Content is the Value required.

F

8.333

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	8.33 3	Cost of a Gallon
	.5	Decimal
Shillings	4.166 5	
	1 2	Pence in a Shilling
(N ^o . 53)	333 0	
	1 665	
Penny	1.998 0	
	4	Farthings
Farthings	3.992 0	

The Value requir'd is 4*s*. 1 $\frac{3}{4}$, and $\frac{999}{1000}$ of a Farthing.

Here may be seen the small Defect in Decimal Arithmetick, because a Gallon cost 8*s*. 4*d*. The Decimal .5 being half the Quantity must cost 4*s*. 2*d*. So there is $\frac{99}{1000}$ of a Farthing wanting; because the Decimal of 4*d*. when the Denominator is 12, cannot be work'd to a Period. So it is in many other Decimal Numbers: However, the Difference is so small from Truth, that they are used by the greatest Mathematicians in most of their Calculations.

Let the Decimal .525 of a Statute Perch of Land, or *London* Rod of Brick-Wall be given; to know how many superficial Feet it contains. The Perch or Rod is 272.25 Feet, which multiply by the given Decimal, the Content is the Feet required.

(N^o. 54.)

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$$\begin{array}{r}
 27 \text{ } 2.25 \text{ } \text{Perch} \\
 \underline{.525} \text{ } \text{Decimal} \\
 136 \text{ } 125 \\
 \text{(N}^\circ \text{. 54.) } 544 \text{ } 50 \\
 \underline{136 \text{ } 125} \\
 \text{Feet } 142.93 \text{ } 125 \\
 \underline{12} \\
 186 \text{ } 250 \\
 \underline{93125} \\
 \text{Inches } 11.17 \text{ } 500
 \end{array}$$



Inches in a Foot

The Decimal contains 142 Feet 11 Inches, and .17500 of an Inch remains

Suppose a *London* Rod of Brick-Wall cost 6*l.* 12*s.* What does .525 of a Rod cost? Look in (N^o. 27.) for the Decimal of 12, and the Money will stand thus, 6.6; which multiply by the given Decimal .525, their Product is the Value required

$$\begin{array}{r}
 .525 \text{ } \text{Decimal} \\
 \underline{6.6} \text{ } \text{Money} \\
 3150 \\
 \underline{3150} \\
 \text{Pounds } 3.4650 \\
 \underline{20} \text{ } \text{Shillings in a Pound} \\
 \text{Shillings } 93000 \\
 \underline{12} \text{ } \text{Pence in a Shilling} \\
 \text{(N}^\circ \text{. 55.) } 6000 \\
 \underline{3000} \\
 \text{Pence } 3.6000 \\
 \underline{4} \text{ } \text{Farthings in a Penny} \\
 \text{Farthings } 2.4000
 \end{array}$$

The Value appears to be 3*l.* 9*s.* 3¹/₂

F 2

The

36. ARITHMETICK, &c. Improv'd.

The following Table shews the Decimals of the several Numbers in a long Hundred of Five-score and Twelve.

Pounds	Dls.	Pounds	Dls.	Pounds	Dls.
112	100	74	.66	37	.33
111	.991	73	.651	36	.321
110	.982	72	.642	35	.312
109	.973	71	.633	34	.303
108	.964	70	.625	33	.294
107	.955	69	.616	32	.285
106	.946	68	.607	31	.276
105	.937	67	.598	30	.267
104	.928	66	.589	29	.258
103	.919	65	.58	28	.25
102	.91	64	.571	27	.241
101	.901	63	.562	26	.232
100	.892	62	.553	25	.223
99	.883	61	.544	24	.214
98	.875	60	.535	23	.205
97	.866	59	.526	22	.196
96	.857	58	.517	21	.187
95	.848	57	.508	20	.178
(N ^o .56.) 94 is	.839	56 is	.5	19 is	.169
93	.83	55	.491	18	.16
92	.821	54	.482	17	.151
91	.812	53	.473	16	.142
90	.803	52	.464	15	.133
89	.794	51	.455	14	.125
88	.785	50	.446	13	.116
87	.775	49	.437	12	.107
86	.767	48	.428	11	.098
85	.758	47	.419	10	.089
84	.75	46	.41	9	.08
83	.741	45	.401	8	.071
82	.732	44	.392	7	.062
81	.723	43	.383	6	.053
80	.714	42	.374	5	.044
79	.705	41	.366	4	.035
78	.696	40	.357	3	.026
77	.687	39	.348	2	.017
76	.678	38	.339	1	.008
75	.669				

The

ARITHMETICK, &c. Improv'd. 37

The following Table shews the Decimals of the several Numbers in a long Hundred of Six-score.

Dls.	Pounds	Dls.	Pounds	Dls.	Pounds	Dls.
	120	100	80	.666	40	.333
.33	119	.991	79	.658	39	.325
.321	118	.983	78	.65	38	.316
.312	117	.975	77	.641	37	.308
.303	116	.966	76	.633	36	.3
.294	115	.958	75	.625	35	.294
.285	114	.95	74	.616	34	.283
.276	113	.941	73	.608	33	.275
.267	112	.933	72	.6	32	.266
.258	111	.925	71	.591	31	.258
.25	110	.916	70	.583	30	.25
.241	109	.908	69	.575	29	.241
.232	108	.9	68	.566	28	.233
.223	107	.891	67	.558	27	.225
.214	106	.883	66	.55	26	.216
.205	105	.875	65	.541	25	.208
.196	104	.866	64	.533	24	.2
.187	103	.856	63	.525	23	.191
.178	102	.85	62	.516	22	.183
.169	(N ^o . 57.) 101 is	.841	61	.508	21	.175
.16	100	.833	60 is	.5	20 is	.166
.151	99	.825	59	.491	19	.158
.142	98	.816	58	.483	18	.15
.133	97	.808	57	.475	17	.141
.125	96	.8	56	.466	16	.133
.116	95	.791	55	.458	15	.125
.107	94	.783	54	.449	14	.116
.098	93	.775	53	.441	13	.108
.089	92	.766	52	.433	12	.1
.08	91	.758	51	.425	11	.091
.071	90	.75	50	.416	10	.083
.062	89	.741	49	.408	9	.075
.053	88	.733	48	.4	8	.066
.044	87	.725	47	.391	7	.058
.035	86	.716	46	.383	6	.05
.026	85	.708	45	.375	5	.041
.017	84	.7	44	.366	4	.033
.008	83	.691	43	.358	3	.025
	82	.683	42	.35	2	.016
	81	.675	41	.341	1	.008
The						Of

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Of reducing Brick and rough Stone-Walls into three several customary Thickneſſes.

In and about *London*, Brick-Walls are generally reduced to 14 Inches, but in moſt other Parts to 9 Inches. I have known ſome Perſons to reduce them to 18 Inches, but never knew the latter brought as a customary Precedent.

The ſeveral Thickneſſes for rough Stone-Walls are 18 Inches, 20 Inches, and 24 Inches; yet I have known ſeveral Diſputes concerning theſe three laſt Articles, which makes it neceſſary to nominate the Thickneſs of the intended Reduction before the Work begins.

The Following Table ſhews the Decimals of the ſeveral Inches contained in a 9 Inch Brick-Wall.

Inches		Decimals
9		100
8		.88
7		.77
6		.66
5	is	.55
4		.44
3		.33
2		.22
1		.11

(N^o. 58.)

Let 7642 Feet of Brick-Wall 24 Inches thick be given, it's required to know how many Feet of 9 Inches thick, that Sum produces. Take the 9's out of the Thickneſs for whole Numbers, and 6 remains; then look in (N^o. 58.) for the

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the Decimal of 6, and the Sum will stand thus, 2.66. Which multiply by the given Feet, their Product is the Sum of Feet required.

	76 42	Feet
	2.66	Thicknefs
	458 52	
(N ^o . 59.)	4585 2	
	15284	
Feet required	20327.72	
	12	Long Inches in a Foot
	1 44	
	7 2	
Long Inches ditto	8.64	

The Sum required is 20327 Feet, 8 long Inches and .64 remains; this last is of too small a Value to be accounted for.

N. B. Observe this general Rule in all Reducements: When the several Dimensions are thrown into Feet, draw out all that are of one Thicknefs into separate Columns, and reduce their Sums into one proposed Thicknefs, before they are divided into Perches.

Suppose a Dimension is 520 Feet and 8 Inches thick (as it sometimes happens in Breaks of Chimnies, &c.) it's required to know how many Feet of 9 Inches thick are contained therein. Look into (N^o. 58.) for the Decimal of 8 Inches,

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ches, which multiply by 520 Feet, their Sum is the Feet required.

	5 20	Feet
	.88	Decimal
(N ^o . 60.)	41 60	
	416 0	
Feet requir'd	457.60	
	12	
	1 20	
	6 0	
Long Inches ditto	7.20	

The Sum required is 457 Feet, 7 long Inches and .20 remains.

N. B. When the Thickness happens to be so many 9's and no Remainder, take no Notice of the Table of Decimals, but multiply the Sum of Feet by their Number; or if the given Sum be one Brick and a half thick, add its Half to the Whole, the Sum is the Number of Feet, at 9 Inches thick.

The following Table shews the Decimals of the several Inches contained in a 14.5 Inches, or one Brick and a half Wall.

Inches

Inches Decimals

14.5		100
14		.965
13		.896
12		.827
11		.758
10		.689
9		.62
8		.551
7		.482
6		.413
5		.344
4		.275
3		.2
2		.137
1		.069
$\frac{1}{2}$		.034

(N^o. 61.)

Let 11749 Feet of Brick-Wall 52 Inches thick be given; to know how many Feet of 14.5, of Brick and a half Wall is contained therein: Take 3 Times 14.5 from 52, which is 43.5 Inches for whole Numbers, and 8.5 Inches remains; then look in (N^o. 61.) for the Decimal of 8 Inches, and that of $\frac{1}{2}$ an Inch, and add the two together, the Sum of the Thickness will stand thus, 3.585: Which multiply by the given Number 11749, their Product is the Sum of Feet required.

G

(N^o. 62.)

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	11 749	Feet
	3.585	Thickness
	58 745	
(N°. 62.)	91 92	
	5874 5	
	35247	
Feet requir'd	41272.165	
	12	Long Inches in a Foot
	330	
	1 65	
Long Inch ditto	1.980	

The requir'd Sum is 41272 and 1 Long Inch, and $\frac{2.8}{100}$ of an Inch remains.

N. B. Observe in this as was mentioned in N. B. (N°. 60.) where the Thickness of the Wall contains so many Bricks breadth, and no odd Inches remains: The foregoing Table is of no Use; but work thus, Let 746 Feet of Wall 2 Bricks thick be given; to know how many Feet of 1 Brick and $\frac{1}{2}$ Wall that Sum will produce; take 1 Brick and $\frac{1}{2}$ out of the Thickness, and $\frac{1}{2}$ a Brick remains equal to $\frac{1}{3}$ of the Whole; therefore add $\frac{1}{3}$ of the given Sum to itself, and it produces the Number of Feet requir'd.

	746	The given Sum
	248.66	One 3d. of ditto
(N°. 63.)	994.66	The Sum required

N. B. If the Thickness be 2 Bricks and $\frac{1}{2}$ thick, add $\frac{2}{3}$ of the given Sum to itself. If 3 Bricks, double the given Sum, and so on.

The

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The following Table shews the several Decimals in a Stone-Wall of 18 Inches thick.

Inches Decimals

18		100
17		.94
16		.88
15		.83
14		.77
13		.72
12		.66
11		.61
10		.55
9	is	.5
8		.44
7		.38
6		.33
5		.27
4		.22
3		.16
2		.11
1		.05



(N^o. 64.)

Let 24967 Feet of Stone-Wall 32 Inches thick be given; to know how many Feet of 18 Inch-Wall that Sum will produce; take 18 Inches the proposed Thickness (for a whole Number) and 14 remains: Then look into (N^o. 64.) for the Decimal of 14 Inches, and the Sum of Thickness will stand thus, 1.77: Which multiply with the given Sum, their Product will be the Number of Feet requir'd,

G 2

(N^o. 65.)

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$$\begin{array}{r}
 249\ 67 \quad \text{Given Sum} \\
 \underline{1.77} \quad \text{Thickness} \\
 1747\ 69 \\
 17476\ 9 \\
 \underline{24967} \\
 \text{Feet required } 44191.59
 \end{array}$$

(N^o. 65.)

The following Table shews the several Decimals in a Stone-Wall of 20 Inches thick.

Inches	Decimals
20	100
19	.95
18	.9
17	.85
16	.8
15	.75
14	.7
13	.65
12	.6
11	.55
10	.5
9	.45
8	.4
7	.35
6	.3
5	.25
4	.2
3	.15
2	.1
1	.05

(N^o. 66.)

Let

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Let 346324 Feet of Stone-Wall 49 Inches thick be given; to know how many Feet of 20 Inch Wall that Sum will produce. Take 40 from the Thickness, and 9 will remain: Then look in (N^o. 66.) for the Decimal of 9 Inches, and the Sum of Thickness will stand thus, 2.45, which multiply by the given Number, gives the Sum requir'd.

	3463 24	Given Sum
	2.45	Thickness
(N ^o . 67.)	17316 20	
	138529 6	
	692648	
Feet required	848493.80	

The following Table shews the several Decimals in a Stone-Wall of 24 Inches thick.

Inches	Decimals	Inches	Decimals
24	1.00	12	.5
23	.95	11	.45
2	.91	10	.41
21	.87	9	.37
20	.83	8	.33
(N ^o . 68.) 19 is	.79	7 is	.29
18	.75	6	.25
17	.7	5	.2
16	.66	4	.16
15	.62	3	.12
14	.58	2	.08
13	.54	1	.04

Let

Let

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Let 34604 Feet of Stone-Wall 103 Inches thick be given; to know how many Feet of 24 Inch-Wall that Sum will produce: First, see how many 24's in 103, say 4 and 7 Inches remains. Then look into (N^o. 68.) for the Decimal of 7 Inches, and the Sum of Thickness will stand thus, 4.29, which multiply by the given Number, their Product is the Sum required.

	346 04	Given Sum
	4.29	Thickness

(N ^o . 69.)	3114 36	
	6920 8	
	138416	

Feet requir'd	148451.16	

Again, let 4623 Feet of Stone-Wall 17 Inches thick be given; to know how many Feet of 24 Inch-Wall it will produce: Look in (N^o. 68.) for the Decimal of 17 Inches, which multiply by the given Feet, their Product is the Sum requir'd.

	4623	Given Sum
(N ^o 70.)	.7	Decimal

Feet requir'd	3236 1	

Of DUODECIMALS.

The only Use of this Rule is to throw Inches and Parts into Feet, and Pence into Shillings, and is generally used by Master-Builders and Measurers in squaring their several Dimensions,

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sions, and judg'd by most to be the best Method for that Purpose.

The Denominator, or Unit, in this Rule, is divided into 12's, which represent the Inches and Parts in a Foot, or Pence and Parts in a Shilling, divided into a Foot or Shilling, and diminishes by that Number till it brings the Sum to a Period, which cannot be done by Decimals of 10's, except the Numbers bear a Proportion to the 4ths of a 100.

Observe, 1 superficial Foot contains 12 Long Inches, 1 Long Inch 12 Short Inches, 1 Short Inch is divided into 12 Parts, 1 of those 12 into 12 Parts, and so on till there is no Remainder. See the following Example, which shews the Value of every Place of Figures to the 1728th Part of a superficial Inch.

	Feet	Parts	2ds	3ds	4ths	5ths
(N ^o . 71.)	1	1	1	1	1	1
	Foot	Long Inch	Short Inch	12 of Short Inch	144 of Short Inch	1728 of Short Inch

ADDITION of DUODECIMALS.

Stop at 12's in all the Parts, and at 10's in the Feet: This must be observed as a general Rule in all Sums work'd by Duodecimals.

Feet

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	Feet	Parts	zds	3ds	4ths	5ths
	12	7	6	3	9	2
	19	2	5	4	0	7
	29	6	5	3	0	0
(N ^o . 72.)	00	0	7	0	8	9
	14	4	2	9	2	6
	03	2	9	3	3	0
Feet	79	0	0	0	0	0

Again, see the following Example.

	Feet	Parts	zds	3ds	4ths	5ths
	29	4	0	7	6	1
	4	0	6	5	1	9
	13	8	2	4	0	6
	15	9	0	0	7	3
(N ^o . 73.)	1	5	3	6	1	8
	36	0	0	9	5	4
	1	1	1	1	1	1
	48	0	0	0	0	0
	0	0	0	7	6	5
	149	4	3	5	6	1
	Feet	Long Inches	Short Inches	12's of Short Inches	144's of Short Inches	1728's of Short Inches

SUB-

SUBTRACTION of DUODECIMALS.

Observe to place the Sum of the greatest Value in the upper Line, and place Cyphers where there are no Parts.

To substract Shillings, Pence and Farthings from Shillings and Pence.

	s.	d.	2ds
(N ^o . 74.)	47	6	0
	9	9	6
	37	8	6
	Shillings	Pence	$\frac{1}{2}$ a Penny

N. B. Observe this general Rule in all Money Sums work'd by Duodecimals, to set in the Place of 2ds the Figure 3 for a Farthing, 6 for a Half-penny, and 9 for three Farthings, because they are so many 12's of a Penny: The same Sum will answer for so many Feet and Parts.

To substract Feet and Parts, from Feet and Parts.

H

(N^o. 75.)

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	Feet	Parts	zds	3ds	4ths	5ths	
(N ^o . 75.)	90	11	7	0	6	2	
	23	5	6	9	3	10	
	67	16	0	3	2	4	Remains
	Feet	Long Inches	Short Inches	12's of Short Inches	144's of Short Inches	1728's of Short Inches	

Say, 10 from 14 and 4 remains; carry 1 to 3 is 4, from 6 and 2 remains; 9 from 12 and 3 remains; carry one to 6 is 7, from 7 and 0 remains; 5 from 11 and 6 remains; 3 from 10 and 7 remains; carry 1 to 2 is 3, from 9 and 6 remains.

To subtract Feet and Parts from Feet.

	Feet	Parts	zds	3ds	4ths	
(N ^o . 76.)	907	0	0	0	0	
	29	7	10	0	11	
	877	4	1	11	1	Remains
	Feet	Long Inches	Short Inches	12's of Short Inches	144's of Short Inches	

Say,

Say, 11 from 12 and 1 remains; carry 1 from 0 and 11 remains; carry 1 to 10 is 11, from 12 and 1 remains; carry 1 to 7 is 8, from 12 and 4 remains; carry 1 to 9 is 10, from 17 and 7 remains; carry 1 to 2 is 3, from 10 and 7 remains; carry 1 from 9 and 8 remains.

MULTIPLICATION of DUODECIMALS.

This Rule is call'd by some Cross Multiplication, because the Parts are work'd by the Feet cross-ways. There are two Methods of working these Dimensions, and both are useful to be known (which I shall shew in the following Examples;) but the most ready for large Dimensions, is that done by the Rule of Practice, which is a Kind of Division mixed with Multiplication; but before a Learner proceeds, he must be acquainted with the equal Parts of 12, as followeth.

	Inches	Parts	
(N ^o . 77.)	1	$\frac{1}{12}$	
	2	$\frac{1}{6}$	
Equal Parts of 3	is	$\frac{1}{4}$	a Foot or Shilling
	4	$\frac{1}{3}$	
	6	$\frac{1}{2}$	

These are equal Parts, but the following are odd Numbers, which must be taken in Pieces thus: Take 4 which is equal to $\frac{1}{3}$ from 5 and 1 remains equal to $\frac{1}{12}$; again, take 6 equal to $\frac{1}{2}$ from 7 and 1 remains equal to $\frac{1}{12}$; again, take 4 equal to $\frac{1}{3}$ from 8 and the same remains; again, take 6 equal to $\frac{1}{2}$ from 9 and 3 remains equal to $\frac{1}{4}$; again, take 6 equal to $\frac{1}{2}$ from 10 and 4 re-

H 2

mains

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mains equal to $\frac{1}{3}$; again, 11 cannot be taken at twice, but must be divided into three Parts, take 6 equal to $\frac{1}{2}$ and 5 remains, then take 4 equal to $\frac{1}{3}$ and 1 remains equal to $\frac{1}{12}$; but 9 and 11 may be work'd a shorter Way, as I shall shew in the proper Examples.

	Inches	Parts	
(N ^o . 78.)	5	$\frac{1}{3}$	$\frac{1}{12}$
	7	$\frac{1}{3}$	$\frac{1}{4}$
Unequal Parts of 8	is	$\frac{1}{3}$	and $\frac{1}{3}$
Divided into 9		$\frac{1}{2}$	$\frac{1}{4}$
	10	$\frac{1}{2}$	$\frac{1}{3}$
	11	$\frac{1}{2}$	$\frac{1}{3}$ $\frac{1}{12}$

a Foot or Shilling
equal Parts

N. B. I shall set an Example of every Number of Inches in a Foot, in order to shew the Work more distinct for the Benefit of Learners; and begin with 2, 3, and so proceed.

To know the Content of 8 Feet 3 Inches, by 5 Feet 2 Inches.

	8	x	3	
	5	-	2	
(N ^o . 79.)	40			
	1	3		
	1	4	6	
	42	7	6	Content
	Feet	Long Inches	Short Inches	

First,

First, multiply Feet by Feet, then 5 Feet by 3 Inches, because 3 is $\frac{1}{4}$ of 12, say the 4's in 5 is 1 Foot and 1 remains equal to 3 Long Inches; then 8 Feet by 2 Inches, because 2 is $\frac{1}{6}$ of 12, say the 6's in 8 is 1 Foot and 2 remains equal to 4 Long Inches; then multiply Inches by Inches, say twice 3 is 6 Short Inches, where the Product of Inches by Inches amounts to 12 or upwards, the 12's are Long Inches, and the Remainder is Short Inches. This Rule is demonstrated by the following double Scale of Feet and Inches, which is adapted to the Example.

A double Scale representing the foregoing Example.

< 8=3 C >

	1	2	3	4	5	6	7	8	
(N ^o . 80.) A	9	10	11	12	13	14	15	16	B
	17	18	19	20	21	22	23	24	
	25	26	27	28	29	30	31	32	
	33	34	35	36	37	38	39	40	
									E

D

Demonstrations, see (N^o. 80.) The Number of Feet are 40, because the Side A contains 5 Feet, the Side B contains 5 Places of 3 Long Inches equal to 1 Foot 3 Long Inches; again, because the Side C contains 8 Feet, the Side D contains 8 Places of 2 Long Inches equal to 1 Foot, 4 Long Inches; this proves the Necessity of working cross-ways, the Corner E is 6 Short Inches, which would be lost if Inches be not multiplied by Inches.

As

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As I said before in the Introduction of Multiplication, that there were two Methods of working this Rule, which I shall shew by the two following Examples; and, I think, the latter is best adapted for small Dimensions, where the Multiplication can be done by Head.

To work 8 Feet 3 Inches, by 5 Feet 2 Inches, by Multiplication of 12's.

	8 - 3	Multiplicand
	5 - 2	Multiplicator
(N ^o . 81.)	1 4 6	
	41 3	
	42 - 7 - 6	Content

Say, twice 3 is 6, and twice 8 is 16, a 4 and carry 1; again 5 times 3 is 15 a 3 and carry 1, and 5 times 8 is 40 and 1 is 41.

N. B. Observe this general Rule, to set the Place of Feet in the Multiplicator, under the last Figure to the Right of the Multiplicand, which gives every Number its proper Place.

This is an excellent Rule for measuring small Dimensions, both superficial and solid, as Marble Slabs, Blocks, &c. of which I shall set down some few Examples, before I proceed with the Rule of Practice.

To know the Content of 6 Feet 3 Inches and $\frac{1}{2}$, by 4 Feet 7 Inches and $\frac{1}{4}$.

(N^o. 82.)

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6 - 3 - 6 Multiplicand
4 - 7 - 3 Multiplier

(N^o. 82.)

1 6 10 6
3 8 0 6
25 2 0

28 - 11 - 7 - 4 - 6

Feet
Long Inches
Short Inches
12's of Short Inches
14's of Short Inches

Say, 3 times 6 is 18, a 6 and carry 1, and 3 times 3 is 9 and 1 is 10, and 3 times 6 is 18 a 6 and carry 1; then 7 times 6 is 42 a 6 and carry 3, and 7 times 3 is 21 and 3 is 24 an 0 and carry 2, and 7 times 6 is 42 and 2 is 44 an 8 and carry 3; again 4 times 6 is 24 an 0 and carry 2, and 4 times 3 is 12 and 2 is 14 a 2 and carry 1, and 4 times 6 is 24 and 1 is 25.

To know the Content of 4 Feet 9 Inches, by 10 Inches and $\frac{1}{2}$.

4 - 9 Multiplicand
0 - 10 - 6 Multiplier

(N^o. 83.)

2 4 6
3 11 6
4 - 1 - 10 - 6

Say,

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Say, 6 times 9 is 54 a 6 and carry 4, and 6 times 4 is 24 and 4 is 28 a 4 and carry 2; then 10 Times 9 is 90 a 6 and carry 7, and 10 times 4 is 40 and 7 is 47 a 11 and carry 3.

To know the Content of 7 Feet 0 Inches and $\frac{3}{4}$, by $\frac{3}{4}$ of an Inch.

	7	0	9		
			0	0	9
			6	3	6
(N ^o . 84.)			0	0	0
	0	0	0		
	0	6	3	6	9
Feet		Long Inches	Short Inches	12's of Short Inches	144's of Short Inches

Multiplicand
Multiplier

Content

To know the Content of 12 Feet, by 7 Inches and $\frac{3}{4}$.

	12			
	0	7	3	
			3	0
(N ^o . 85.)		7	0	
		7	3	0
		7	3	0
		Long Inches		
Feet				

Multiplicand
Multiplier

Content

To

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To know the Content of a Block 6 Feet 4 Inches and $\frac{1}{2}$ long, 4 Feet 5 Inches and $\frac{1}{2}$ wide, and 3 Feet 2 Inches and $\frac{1}{2}$ deep.

	6 - 4 - 6				Length	
	4 - 5 - 3				Breadth	
(N ^o . 86.)	1	7	1	6		
2	7	10	6			
25	6	0				
28 - 3 - 5 - 7 - 6				Superficial Content		
				3 - 2 - 3		Depth
7 - 0 - 10 - 4 - 10 - 6						
4 - 8 - 6 - 11 - 3 - 0						
84 - 10 - 4 - 10 - 6						
90 - 2 - 0 - 8 - 1 - 10 - 6						
Cube Feet	Cube Inches	Cube Inches	Cube Inches	Cube Inches	Cube Inches	Cube Inches
	Great Cube Inches	Long Cube Inches		12's of Cube Inches	144's of Cube Inches	1728's of Cube Inches

N. B. The Great Inch is 144 Cube Inches, and the Long Inch is 12 ditto.

The two last Figures to the Right, in the superficial Content, may be thrown away being of small Value, but was work'd in the Example,

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ample, to shew that this Rule brings all Dimensions to a Period.

Of Large Dimensions done by the RULE of PRACTICE.

To know the Content of 3 Feet 1 Inch, by 15 Feet 2 Inches.

(N^o. 87.)

$$\begin{array}{r}
 31 \overline{) 15} \begin{array}{l} \text{1} \\ \text{2} \end{array} \\
 \underline{15} \\
 0 - 2 \\
 5 - 2 \\
 1 - 3 \\
 155 \\
 31 \\
 \hline
 471 - 5 - 2
 \end{array}$$

Content

Feet	Long Inches	Short Inches
------	----------------	-----------------

First, Multiply Inches by Inches; say, twice 1 is 2 Short Inches; then 2 Inches by 31 Feet, because 2 is $\frac{1}{6}$ of a Foot, say the 6's in 31 is 5 Feet and 1 remains equal to 2 Long Inches; then 15 Feet by 1 Inch, because 1 Inch is $\frac{1}{12}$ of a Foot, say the 12's in 15 is 1 Foot and 3 Long Inches remains, then multiply Feet by Feet.

To know the Content of 76 Feet 3 Inches, by 39 Feet 4 Inches.

(N^o. 88.)

$$\begin{array}{r}
 76 \overline{) 3} \\
 39 \overline{) 4} \\
 \hline
 1 \\
 (N^{\circ}.88.) \quad 25 - 4 \\
 \quad \quad 9 - 9 \\
 \quad \quad 684 \\
 \quad \quad 228 \\
 \hline
 2998 - 2 \quad \text{Content}
 \end{array}$$

Multiply Inches by Inches, say 4 times 3 is 12 equal to 1 Long Inch, then 76 Feet by 4 Inches, because 4 Inches is $\frac{1}{3}$ of a Foot, say the 3's in 7 is 2, and the 3's in 16 is 5 Feet and 1 remains equal to 4 Long Inches; then 39 Feet by 3 Inches, because 3 Inches is $\frac{1}{4}$ of a Foot, say the 4's in 39 is 9 Feet and 3 remains equal to 9 Long Inches; then multiply Feet by Feet.

To know the Content of 764 Feet 5 Inches by 429 Feet 6 Inches.

$$\begin{array}{r}
 764 \overline{) 5} \\
 429 \overline{) 6} \\
 \hline
 2 - 6 \\
 382 - 0 - 0 \\
 143 - 0 - 0 \\
 (N^{\circ}.89.) \quad 35 - 9 \\
 \quad \quad 6876 \\
 \quad \quad 1528 \\
 \quad \quad 3056 \\
 \hline
 328316 - 11 - 6 \quad \text{Content} \\
 \quad \quad I \ 2 \quad \quad \text{Multiply}
 \end{array}$$

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Multiply Inches by Inches, say 6 times 5 is 30, equal to 2 Long Inches and 6 Short ones remain; then 764 Feet by 6 Inches, because 6 Inches is $\frac{1}{2}$ a Foot, say the $\frac{1}{2}$ of 7 is 3, the $\frac{1}{2}$ of 16 is 8, and the $\frac{1}{2}$ of 4 is 2 and 0 remains; then 429 Feet by 5 Inches, because 5 is no equal Part of a Foot: Work by 4, that being $\frac{2}{3}$ of a Foot, say the 3's in 4 is 1, the 3's in 12 is 4, and the 3's in 9 is 3; then by 1 Inch, say, the 12's in 42 is 3, the 12's in 69 is 5 and 9 Long Inches remain; then multiply Feet by Feet.

To know the Content of 94 Feet 7 Inches, by 83 Feet 8 Inches.

$$\begin{array}{r}
 94 \text{ } \overline{) 7} \\
 83 \text{ } \overline{) 8} \\
 \hline
 4 - 8 \\
 31 - 4 \\
 31 - 4 \\
 41 - 6 \\
 6 - 11 \\
 282 \\
 752 \\
 \hline
 7913 - 5 - 8 \text{ Content}
 \end{array}$$

Multiply Inches by Inches, say 8 times 7 is 56, the 12's in 56 is 4 Long Inches, and 8 Short ones remain; then 94 Feet by 8 Inches, because 8 is no equal Part of 12; work by 4 twice repeated, say the 3's in 9 is 3, the 3's in 4 is 1 and 1 remains equal to 4 Long Inches; so again, then 83 Feet by 7 Inches, because 7 is

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is no equal Part of 12, work by 6, say the $\frac{1}{2}$ of 8 is 4, the $\frac{1}{2}$ of 3 is 1; and $\frac{1}{2}$ remains equal to 6 Long Inches; then by 1, say the 12's in 83 is 6 and 11 Long Inches remain; then multiply Feet by Feet.

To know the Content of 37 Feet 9 Inches, by 23 Feet 10 Inches.

$$\begin{array}{r}
 37 \text{ } ^{\text{--}} \text{ } 9 \\
 23 \text{ } ^{\text{--}} \text{ } 10 \\
 \hline
 \end{array}$$

(N^o. 91.)

$$\begin{array}{r}
 18 - 6 \\
 12 - 4 \\
 11 - 6 \\
 5 - 9 \\
 111 \\
 74 \\
 \hline
 899 - 8 - 6 \quad \text{Content}
 \end{array}$$

Say, 10 times 9 is 90, the 12's in 90 is 7 Long Inches and 6 short ones remain; then 37 Feet by 10 Inches, because 10 is no equal Part of 12, work by 6 and 4: Say, the $\frac{1}{2}$ of 3 is 1, the $\frac{1}{2}$ of 17 is 8 and $\frac{1}{2}$ remains equal to 6 Long Inches; then by 4, say, the 3's in 3 is 1, the 3's in 7 is 2 and 1 remains equal to 4 Long Inches; then 23 Feet by 9 Inches, because 9 is no equal Part of 12, work by 6 and 3, say, the $\frac{1}{2}$ of 2 is 1, the $\frac{1}{2}$ of 3 is 1 and $\frac{1}{2}$ remains equal to 6 Long Inches; then by 3, say, the 4's in 23 is 5 and 3 remains equal to 9 Long Inches: Or thus; say, the $\frac{1}{2}$ of 23 Feet is 11 and 6 Long

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Long Inches, and the $\frac{1}{2}$ of 11 Feet 6 Long Inches is 5 Feet 9 Long Inches, because 3 is the $\frac{1}{2}$ of 6, therefore its Product must be so in Proportion; then multiply Feet by Feet.

To know the Content of 32 Feet 11 Inches by 18 Feet.

$$\begin{array}{r}
 32 \text{ } \overline{) 11} \\
 18 \text{ } \overline{) 0} \\
 \hline
 \end{array}$$

(N^o. 92.)

$$\begin{array}{r}
 9 \\
 6 \\
 1 - 6 \\
 256 \\
 32 \\
 \hline
 592 - 6
 \end{array}$$

Work 18 Feet by 11 Inches, because 11 is no equal Part of 12, work by 6, 4 and 1, say, the $\frac{1}{2}$ of 18 is 9; then by 4, say the 3's in 18 is 6; then by 1, say the 12's in 18 is 1 and 6 Long Inches remains: Or thus; take 18 Inches from 18 Feet, and 16 Feet 6 Long Inches remain for the Content; then multiply Feet by Feet.

To know by the Rule of Practice the Content of 16 Foot 3 Inches and $\frac{1}{2}$, by 14 Foot 7 Inches and $\frac{1}{4}$.

First, Observe Parts of Inches by Parts of Inches, the 12's are 12's of Short Inches, and the Remainders are 144's of Short Inches; Parts of Inches by Inches, the 12's are Short Inches, and the Remainder is 12's of Short Inches; Parts of Inches by Feet, the 12's are Long Inches, and the Remainder is Short Inches; again, Inches by

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by Inches, the 12's are Long Inches and the Remainder is Short Inches; again, Inches by Feet, the 12's are Feet and the Remainder is Long Inches. See the following Example.

$$\begin{array}{r} 16 - 3 - 6 \\ 14 - 7 - 3 \end{array}$$

(N^o. 93.)

$$\begin{array}{r} 0 - 1 - 6 \\ 0 - 9 \\ 4 - 0 \\ 0 - 3 - 6 \\ 0 - 1 - 9 \\ 8 - 0 \\ 1 - 4 \\ 0 - 7 \\ 3 - 6 \\ 64 \\ 16 \end{array}$$



$$\begin{array}{r} 237 - 11 - 1 - 4 - 6 \\ \text{Feet} \quad \text{Long Inches} \quad \text{Short Inches} \quad \text{12's of Short Inches} \quad \text{144's of Short Inches} \end{array}$$

N. B. Carry on the Work as the cross Lines direct; begin with 2ds by 2ds, say, 3 times 6 is 18 equal to $\frac{1}{81}$ of a Short Inch, and $\frac{6}{144}$ of the same; then

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then 2ds by Parts, say 3 times 3 is $\frac{9}{2}$ of a Short Inch; then Feet by 2ds, say the 4's in 16 are 4 Long Inches; then Inches by Parts, say the $\frac{1}{2}$ of 7 is 3 Short Inches and $\frac{6}{2}$; then Inches by Inches, say 7 times 3 is 21 equal to 1 Long Inch and 9 Short Inches; then 16 Feet by 7 Inches, say the $\frac{1}{2}$ of 16 is 8, and the 12 in 16 is 1 Foot 4 Long Inches; then 14 Feet by 6 Seconds, say the $\frac{1}{2}$ of 14 is 7 Long Inches; then 14 Feet by 3 Inches, say the 4's in 14 is 3 Feet and 2 remains equal to 6 Long Inches; then multiply Feet by Feet.

To know the solid Content of a Piece of Timber 25 Feet long, Scantling 1 Foot 3 Inches, by 1 Foot 2 Inches.

1 - 3	Breadth
1 - 2	Depth
2 - 6	
1 - 3	
1 - 5 - 6	
25	Feet Long
1 - 0 - 6	
8 - 4	
2 - 1	
25	
36 - 5 - 6	Content

(N^o. 94.)
Say, twice 3 is 6, and twice 1 is 2, then once 3 is 3, and once 1 is 1; again by the Length 25 Feet, say the $\frac{1}{2}$ of 25 is 12 equal to 1 Foot, and 6 Long Inches remain equal to $\frac{1}{2}$ a Great Inch or 72 Cube Inches; then 25 Feet by 5 Inches, say the 3's in 25 is 8 Feet and

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and 1 remains equal to 4 Great Inches; then the 12's in 25 is 2 Feet and 1 Great Inch remains; then Feet by Feet.

See the same Dimension the common Way.

153 } Inches
143

60

15

210

25 Feet Long

1050

420

144)5250(36 Feet

432

930

864

66

12 Great Inches in a Foot

132

66

144)792(5 Great Inches

720

72

12 Long Inches in a Great Inch

144

72

144)864(6 Long Inches

864

0

K

So



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So the Content is 36 Feet, 5 Great Inches and 6 Long Inches.

To know the Content of a Piece of Timber, 31 Feet 6 Inches Long, Scantling 1 Foot 5, by 1 Foot 5.

	1 - 5 -	}	Scantling
	1 - 5		
(N ^o . 96.)	7 - 1		
	1 - 5		
	2 - 0 - 1		
	31 - 6		Length
	1 - 0 - 0 - 6		
	0 - 2 - 7		
	62		
	63 - 2 - 7 - 6		Content
Feet	Great Inches	Long Inches	Cube Inches

Say, 5 times 5 is 25 a 1 and carry 2, and 5 times 1 is 5 and 2 is 7; then once 5 once 1; then 6 times 1 is 6 and 6 times 0 is 0, and 6 times 2 is 12 a 0 and carry 1; again, 31 by 1, the 12's in 31 is 2 Great Inches and 7 Long Inches remains; then Feet by Feet.

See the same Dimension the common Way.

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17 } Inches
 17 }

119

17

289

31 - 6 Feet Long

144 - 6

289

867

144)9103 - 6(63 Feet

864

463

432

31 - 6 Remainder

12 Great Inches in a Foot

(N^o. 97.)

62

316 The 6 Inches are added

144)378(2 Great Inches

288

90

12

180 Long Inches in a Great Inch

90

144)1080(7 Long Inches

1008

72

12

144 Cube Inches in a Long Inch

72

144)864(6 Cube Inches

864

0

K 2

The

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The Content is 63-2-7-6. See (N^o. 96.)

To know the solid Content in Yards of a Cellar, 33 Feet 4 Inches Long, 25 Feet 6 Inches Wide, and 7 Feet 9 Inches Deep.

$$\begin{array}{r}
 33 \overline{) 4} \\
 \underline{25} \\
 0 - 2 \\
 16 - 6 \\
 8 - 4 \\
 165 \\
 66 \\
 \hline
 \end{array}$$

(N^o. 98.)

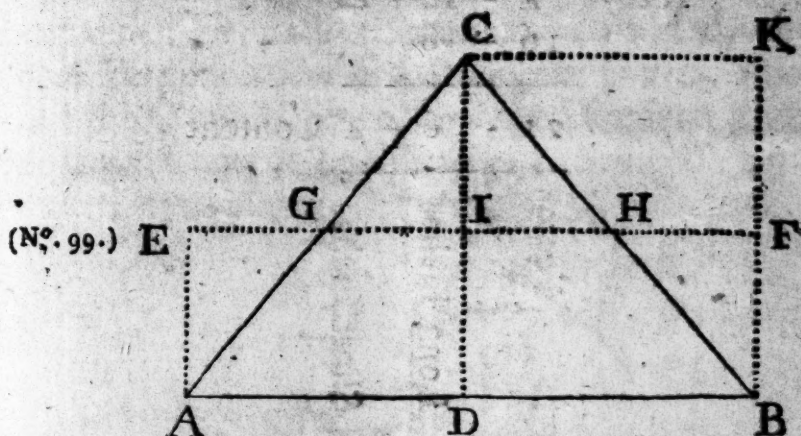
$$\begin{array}{r}
 849 \overline{) 0} \\
 \underline{7} \\
 424 - 6 \\
 212 - 3 \\
 5943 \text{ Yards Feet Inches} \\
 27 \overline{) 6579} - 9(243 - 18 - 9 \\
 54 \\
 \hline
 117 \\
 108 \\
 \hline
 99 \\
 81 \\
 \hline
 18 - 9 \text{ Remains}
 \end{array}$$

First, multiply Inches by Inches; say, the $\frac{1}{2}$ of 4 is 2; then 33 Feet by 6 Inches, say the $\frac{1}{2}$ of 3 is 1, the $\frac{1}{2}$ of 13 is 6 and 6 Long Inches remains; then 25 Feet by 4 Inches, the 3's in

25 is 8 and 1 remains equal to 4 Long Inches; then Feet by Feet: Again, work 849 Feet by 9 Inches, because 9 is no equal Part of 12, work by 6 and 3, say the $\frac{1}{3}$ of 8 is 4, the $\frac{2}{3}$ of 4 is 2, the $\frac{1}{3}$ of 9 is 4 and 6 Great Inches remains; then the $\frac{1}{3}$ of 424 Feet 6 is 212 Feet 3 Inches; then Feet by Feet, and divide by 27 for Cube Yards.

Of the MEASUREMENT of ANGLES.

Observe this Rule in the Measurement of all Angles: Multiply the whole Base by $\frac{1}{2}$ the Perpendicular, or the whole Perpendicular by $\frac{1}{2}$ the Base. See the following Demonstration.



See Fig. (N^o. 99.) The Line EF is equal and parallel to the Base AB, and cuts the Perpendicular CD in the Middle at I, because the Angle CIG is equal to the Angle GEA, and the Angle CIH to the Angle HFB; therefore the Parallelogram AEFB is equal to the Angle ACB, which proves the whole Base by $\frac{1}{2}$ the Perpendicular to be the true Measure of the given Angle ACB; again, the Perpendicular CD cuts

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cuts the whole Angle and Base in the Middle, and the Line BK is equal and parallel to CD, and the Angle CKB is equal to the Angle BDC or CDA, and the Parallelogram, CKBD must be equal to the given Angle ACB; which also proves that the whole Perpendicular, by $\frac{1}{2}$ the Base, gives the true Measure of the given Angle ACB.

To know the Content of an Angle whose Base is 8 Feet 4 Inches, and its Perpendicular 5 Feet 2 Inches.

8 - 4	Whole Base
2 - 7	Half Perpendicular
(N ^o . 100.) 4 - 10 - 4	
16 - 8	
21 - 6 - 4	Content
Feet	
Long Inches	
Short Inches	

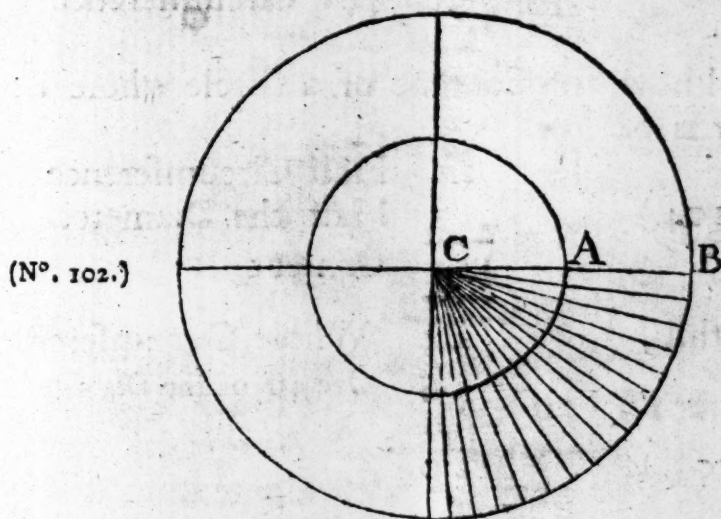
Or thus,	5 - 2	Whole Perpendicular
	4 - 2	Half Base
	10 - 4	
(N ^o . 101.)	20 - 8	
	21 - 6 - 4	Content

Of

Of the MEASUREMENT of CIRCLES.

Observe this general Rule: Multiply $\frac{1}{2}$ the Circumference by $\frac{1}{2}$ the Diameter, or the whole Circumference by $\frac{1}{4}$ of the Diameter. Demonstration: A Circle contains an infinite Number of Angles tending to the Center, whose Base is the Circumference, and $\frac{1}{2}$ the Diameter their Perpendicular.

See (N^o. 102.) Because the Circumference B is their Base, and AB $\frac{1}{2}$ of the Diameter is $\frac{1}{2}$ their Perpendicular CB, the whole Circumference multiplied by $\frac{1}{2}$ of the Diameter proves to be the Measure of the Circle; again, $\frac{1}{2}$ the Circumference or Base B multiplied by CB, the whole Perpendicular or $\frac{1}{2}$ Diameter proves, also, that $\frac{1}{2}$ the Circumference, by $\frac{1}{2}$ the Diameter gives the same Content or Measure. See (N^o. 99.) for the Demonstration of Angles.



The next Thing to be considered, is to find the Length of the Circumference by a given Diameter;

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Diameter ; which in common Practice is, As the Diameter 7 is to 22 the Circumference, so is the given Diameter to the required Circumference ; and it must be observed, that the Length of Curves, and most other mathematical Proportions cannot so well be found by Duodecimals as by Decimals of 10's ; therefore I shall execute most of the following Examples by the latter Rule.

Let the Diameter of a Circle be 14 Feet ; to know the Circumference, work by the Rule of 3, say as 7 is to 22, so is 14 the given Diameter to the Circumference required.

$$\begin{array}{r}
 7 = 22 = 14 \\
 \quad \quad 14 \\
 \hline
 \text{(N}^\circ. 103.) \quad 88 \\
 \quad \quad 22 \\
 \hline
 7)308(44 \quad \text{Circumference}
 \end{array}$$

To know the Content of a Circle whose Diameter is 14 Feet.

$$\begin{array}{r}
 \text{(N}^\circ. 104.) \quad 22 \quad \text{Half Circumference} \\
 \quad \quad \quad 7 \quad \text{Half the Diameter} \\
 \hline
 \quad \quad 154 \quad \text{Content} \\
 \hline
 \text{Or thus,} \quad 44 \quad \text{Whole Circumference} \\
 \quad \quad 3.5 \quad \text{One 4th of the Diameter} \\
 \hline
 \text{(N}^\circ. 105.) \quad 220 \\
 \quad \quad 132 \\
 \hline
 \quad \quad 154.0 \quad \text{Content}
 \end{array}$$

An-

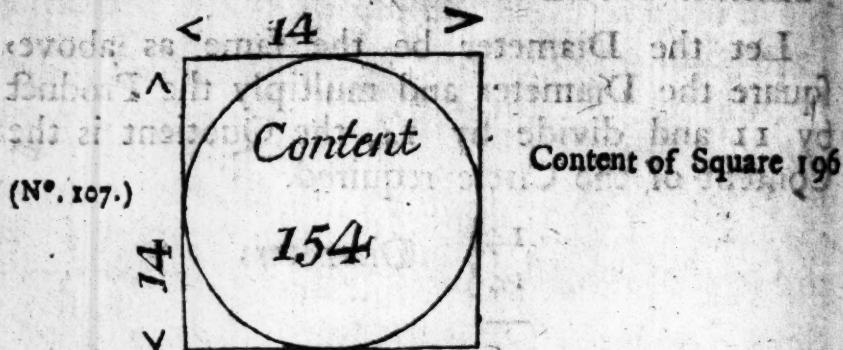
Another RULE to Measure a CIRCLE.

Let the Diameter be the same as above, square the Diameter and multiply the Product by 11 and divide by 14, the Quotient is the Content of the Circle required.

$$\begin{array}{r}
 14 \} \text{ Diameters} \\
 14 \} \\
 \hline
 56 \\
 14 \} \\
 \hline
 196 \cdot \text{Content of Diameter} \\
 11 \} \\
 \hline
 \text{(Nº. 106.) } 196 \\
 196 \\
 \hline
 14)2156(154 \text{ Content} \\
 14 \cdot \\
 \hline
 75 \\
 70 \\
 \hline
 56 \\
 56 \\
 \hline
 0
 \end{array}$$

L

(Nº. 107.)



It may be ask'd from whence these Proportions derive? Answer, The Content of the Circle is to the Square of the Diameter, as 11 is to 14. For Example, a Square whose Sides are 14 contains 196, and a Circle whose Diameter is 14 contains 154, as in the foregoing Example, which to prove, divide the two Contents each by 14, the Quotient of the former will be 14, and the Quotient of the latter 11. See the two following Examples.

(N^o. 108.)

$$\begin{array}{r}
 14 \overline{) 196} (14 \\
 \underline{14} \\
 56 \\
 \underline{56} \\
 0
 \end{array}$$

(N^o. 109.)

$$\begin{array}{r}
 14 \overline{) 154} (11 \\
 \underline{14} \\
 14 \\
 \underline{14} \\
 0
 \end{array}$$

These

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These Examples shew the Derivation of the Numbers 11 and 14; but the Reason of their Application is thus, The Content of the Diameters Square, See (N^o. 107.) is supposed to be divided into 14 equal Parts, and the Content of the Circle inscribed therein is equal to 11 of those Parts; therefore the Content of the Square is multiplied by 11, and divided by 14 to give the Value of the 11 Parts contained in the Circle. The Reason of this Rule may be accounted for in this plain Manner. Suppose 45^l. was to be divided into 9 Parts, and 6 of those Parts were requir'd? It's known by Head, $\frac{2}{3}$ of 45 is 30; however, multiply 45 by 6, and divide by 9, the Quotient is 30. See the following Example.

(N^o. 110.)

$$\begin{array}{r} 45 \\ 6 \overline{) 270} \end{array}$$

To find the Content of a Circle by squaring the Diameter, and multiplying its Product by the given Decimal .7857. Let the Diameter be 14.

(N^o. 111.)

$$\begin{array}{r} 14 \} \text{ Diameters} \\ 14 \} \\ \hline 56 \end{array}$$

$$\begin{array}{r} 14 \\ 196 \\ .7857 \text{ Decimals} \\ \hline 1372 \\ 980 \\ 1568 \\ 1372 \\ \hline 153.9972 \text{ Content} \end{array}$$

L 2

The

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The given Decimal is found thus,

$$\begin{array}{r}
 14 = 100 = 11 \\
 11 \\
 \hline
 100 \\
 100 \\
 \hline
 14 \overline{) 1100} (.7857 \text{ Decimal} \\
 \underline{98} \cdot \\
 120 \\
 \underline{112} \\
 80 \text{ Add a Cypher} \\
 \underline{70} \\
 100 \text{ Add a Cypher} \\
 \underline{98} \\
 2
 \end{array}$$

(N^o. 112.)

To find the Diameter of a Circle, whose Area shall contain a given Number, let 154 be the supposed Area, which multiply by 14 and divide by 11, the square Root of the Quotient is the Diameter required.

$$\begin{array}{r}
 154 \text{ Given Area} \\
 \underline{14} \\
 616 \\
 (N^o. 113.) \quad 154 \\
 11 \overline{) 2156} (196 \text{ Quotient} \\
 \underline{11} \cdot \cdot \\
 105 \\
 \underline{99} \\
 66 \\
 \underline{66} \\
 0
 \end{array}$$

Divisor

Divisor Dividend Quotient

1) 196(14) Root or Diameter re-
I required

(N°. 114.) 24)096
96
—
0

N. B. This Rule, except extracting the Root, is no other than (N^o. 106.) reversed.

Of the Square R O O T.

The Square Root is somewhat more difficult to be understood than other common Rules ; but is of so excellent Use in many Things, that a Person cannot make any material Progress in the Mathematicks (nor with Justice call himself a proper Measurer) without a perfect Knowledge thereof. It is work'd in some Measure like Division, and consists of Divisor, Dividend and Quotient (the latter is the Root.) Observe this general Rule in all the whole Numbers of the Dividend, when they are even in Number of Places ; begin with 2 Figures and so continue, but if they are odd as in (N^o. 114.) begin with the first to the Left, and bring down the other by two Places of Figures to every Period. See (N^o. 114.) Begin with 1 to the Left, say the Square of 1 is 1 Place, 1 in the Quotient and 1 in the Divisor, and say once 1 is 1 from 1 and 0 remains, make a Dot over 1 to denote it has been work'd ; then bring down 96 and double the first Divisor 1, which bring down to a second Divisor, and mind to leave Room to the Right

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Right of the new Divisor for another Figure; then consider how many 2's in 9, say 4, set 4 in the Quotient and 4 in the Divisor, and multiply as in Division; say 4 times 4 is 16 a 6 and carry 1, and 4 times 2 is 8 and 1 is 9; then subtract 96 from 96 and 0 remains; the Root is 14 without any Remainder.

Suppose a cylindrical Vessel was to be made 25 Inches deep, and to contain 84973 Cube Inches, it is required to know the Diameter? First, divide the given Number of Inches by 25, and multiply the Quotient by 14, and divide by 11, the Square Root of the last Quotient is the Diameter required.

Divisor	Dividend	Quotient
25	84973	(3398.92
• 75		To be carried to the next Example
—		
	99	
	75	
	—	
	247	
(N°. 115.)	225	
	—	
	223	
	200	
	—	
	230	Add a Cypher
	225	
	—	
	50	Add a Cypher
	50	
	—	
	0	

3398.92

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3398.92
14 Given Number

13595 68
33989 2

Given Numbers I I) 47584.88 (4325.898 Carried to next
44 Example

35
33

(N^o. 116.) 28
22

64
55

98 Make a Dot in the Quotient
88

108
99

90 Add a Cypher
88

20 Add a Cypher

11
—
9

Bring

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Bring down the Quotient, and extract its Square Root.

	Dividend	Quotient
Divisor	6)4325.8981	(65.7715 Root
	36	

125) 725
625

1307)10089
(N^o. 117.) 9149

13147)94081
92029

131541)205200 Add 2 Cyphers
131541

1315425)7365900 Add 2 Cyphers
6577125

788775 Remains

The required Diameter is 65 Inches, and $\frac{7715}{10000}$ of an Inch.

Now prove the Work by multiplying the Root in itself, and adding the Remainder: If the Work is right, the Product will be equal to the Quotient, and the 4 Cyphers which were added in carrying on the Work.

(N^o. 118.)

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$$\begin{array}{r}
 65.7715 \\
 65.7715 \\
 \hline
 \text{(N}^\circ. 118.) \quad 3 \ 28 \ 8575 \\
 \quad \quad \quad 6 \ 57 \ 715 \\
 \quad \quad \quad 4 \ 60 \ 40 \ 05 \\
 \quad \quad \quad 46 \ 04 \ 00 \ 5 \\
 \quad \quad \quad 328 \ 85 \ 75 \\
 \quad \quad \quad 3946 \ 29 \ 0 \\
 \hline
 \quad \quad \quad 4325.89 \ 02 \ 1225 \quad \text{Product} \\
 \quad \quad \quad .78 \ 8775 \quad \text{Remainder} \\
 \hline
 \quad \quad \quad 4325.89 \ 81 \ 0000 \quad \text{Proof}
 \end{array}$$

See (N^o. 117.) Because the Places of whole Numbers are equal, work 43, their greatest square Number is 6; set 6 in the Quotient and 6 in the Divisor, and multiply as in Divison; say 6 times 6 is 36 from 43 and 7 remains; then bring down 25 to 7 and double 6 in the first Divisor, and bring it down to the second Divisor, and observe as before caution'd in (N^o. 114.) to leave Room for a Figure to be added on the Right, because as yet, there is only 12 supposed to be in the second Divisor; then consider how many 12's in 72, perhaps, it may be thought to go 6 times; but by multiplying it is found 5, place 5 in the Quotient and 5 in the Divisor, say 5 times 5 is 25 a 5 and carry 2, and 5 times 2 is 10 and 2 is 12 a 2 and carry 1, and 5 times 1 is 5 and 1 is 6, from 725 and 100 remains; make a Dot in the Quotient, bring down the Decimals 89; then double the last

M

Figure

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Figure of the second Divisor, and bring it down to a third, which makes 130, the 7 is supposed to be as yet unknown; consider how many 13's in 100, or 130's in 1008, say 7, set 7 in the Divisor and 7 in the Quotient, and multiply as in Divison, the Product is 9149 from 10089 and 940 remains, to which bring down 81, double the last Figure of the third Divisor, and bring it down with the other Figures to a fourth Divisor, which makes 1314, the 7 being supposed as yet unknown; then consider how many times 13 in 94, or 131 in 940, say 7, multiply as before and the Product will be 92029, from 94081 and 2052 remains: Now the Dividend is all brought down, it may be carried as far as a Person pleases, by adding 2 Cyphers to every Remainder, and doubling the last Figure of each Divisor.

To extract the square Root of 6985449.

This being an odd Number of Figures, begin with the first to the Left.

$$\begin{array}{r}
 \begin{array}{r}
 \overset{\cdot}{2})\overset{\cdot}{6}\overset{\cdot}{9}\overset{\cdot}{8}\overset{\cdot}{5}\overset{\cdot}{4}\overset{\cdot}{9}\overset{\cdot}{9}(2643.09 \\
 \underline{4} \\
 46)298 \\
 \underline{276} \\
 524)2254 \\
 \underline{2096} \\
 5283)15899 \\
 \underline{15849} \\
 52869)500000 \\
 \underline{475821} \\
 24179
 \end{array}
 \end{array}$$

(N^o. 119.)

Add 2 Cyphers
Add 2 more
Remains

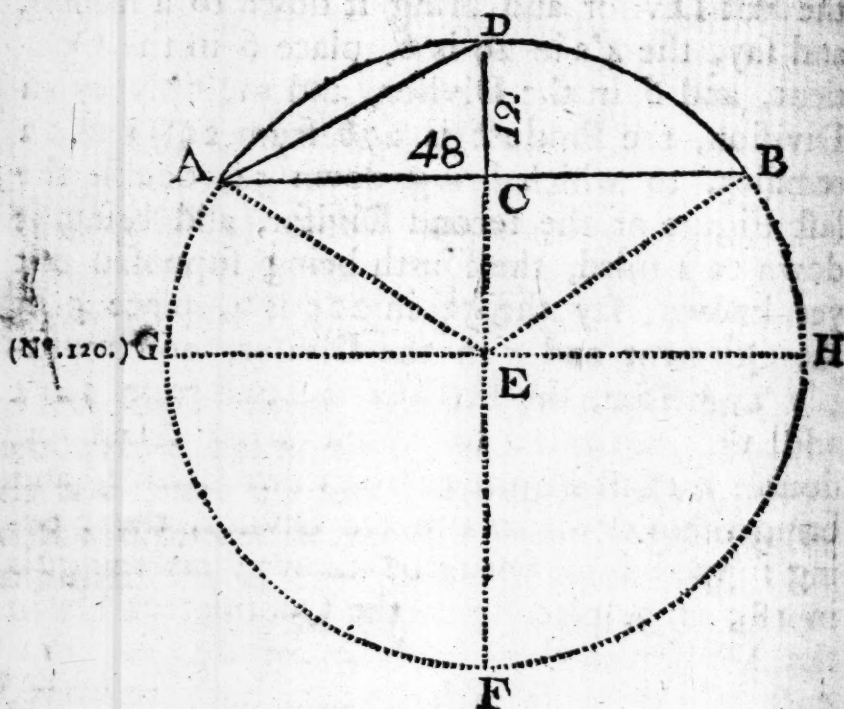
Say,

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Say, the Square Number in 6 is 2, place 2 in the Quotient and 2 in the Divisor, and multiply as in Division, say twice 2 is 4 from 6 and 2 remains, to which bring down 98; then double the first Divisor and bring it down to a second, and say, the 4's in 29 is 6, place 6 in the Quotient, and 6 in the Divisor, and multiply as in Division, the Product is 276 from 298 and 22 remains, to which bring down 54, double the last Figure of the second Divisor, and bring it down to a third, the fourth being supposed not yet known; say the 52 in 225 is 4, place 5 in the Quotient and 5 in the Divisor, and multiply as before, the Product is 2096 from 2254 and 158 remains; to which bring down 99, double the last Figure of the third Divisor, and bring them down to a fourth Divisor, the 3 being supposed not yet to be known; say the 52's in 185 is 3, place 3 in the Quotient and 3 in the Divisor, and multiply as before, the Product is 15849 from 15899 and 50 remains; add 2 Cyphers to the 50 and make a Dot in the Quotient; then double the last Figure of the fourth Divisor, and bring it down to the fifth, the Divisor 5286 is larger then the Dividend 5000; because there has been 2 Cyphers added thereto, and it does not exceed the Divisor, add a Cypher to the Quotient, and two more to the Dividend, and by working as before the Figure 9 will be found, which add to the Quotient and Divisor and multiply and subtract as before; and so you may continue by adding Cyphers, but the second or third Places of Decimals is sufficient for any practical Business.

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To measure the Segment of a Circle, whose Base or Cord-Line is 48 Inches, and its perpendicular Height or Versed Sine 12 Inches. See (N^o. 120.)



As the Measurement of a Circle is demonstrated by its Area, containing an infinite Number of Angles tending to the Center, whose Cord or Base is the Circumference. See (N^o. 102.) for the same Cause the Area of the Sector AD BE must be found; from which subtract the Area of the Angle ABE, the Remainder is the Area of the Segment ADBA.

Observe: Square AC, half the given Cord, and divide its Content by the Versed Sine CD, the Quotient is the Length of CF, to which add CD, their Sum is DF or GH. See the following Example.

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24 } Half the Cord-Line e-
24 } qual to A C

(N^o. 121.)

96
48

12)576(48 Equal to CF

48 | 12 Verfed Sine CD

96 | 60 Diameter FD or GH
96
0

The Diameter of the whole Circle being found, the next Line wanting is the Hypothenufe A D, square A C and C D, and add the Products together; then extract the square Root of their Sum, the Quotient is the Hypothenufe. See the following Examples.

24 } - Half the Cord-Line e-
24 } qual to A C

(N^o. 122.)

96
48

576 } 2 Products added
144 }

720 Carried to (N^o. 124.)

(N^o. 123.)

12 } Verfed Sine CD
12 }

24
12
144 Product

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$$\begin{array}{r}
 2 \overline{) 720} (25.832 \quad \text{Root or Cord AD} \\
 \underline{4} \\
 46 \overline{) 320} \\
 \underline{276} \\
 528 \overline{) 4400} \quad \text{Add 2 Cyphers} \\
 \underline{4224} \\
 5363 \overline{) 17600} \quad \text{Add 2 Cyphers} \\
 \underline{16089} \\
 53662 \overline{) 151100} \quad \text{Add 2 Cyphers} \\
 \underline{107324} \\
 43776 \quad \text{Remains}
 \end{array}$$

Next, multiply the Root last found by 8, then from the Product subtract AB, the Cord of the Segment, and divide the Remainder by 3, the Quotient is the Length of the Arch-Line ADB. See the following Examples.

$$\begin{array}{r}
 26.832 \quad \text{Root or Cord AD} \\
 8 \quad \text{Given Number} \\
 \hline
 214.656 \quad \text{Product} \\
 48.000 \quad \text{AB} \\
 \hline
 \text{Given Number } 3 \overline{) 166.656} (55.552 \quad \text{Arch-Line ABD} \\
 \underline{15} \quad \cdot \cdot \cdot \\
 16 \\
 \underline{15} \\
 16 \\
 \underline{15} \\
 15 \\
 \underline{15} \\
 06 \\
 \underline{00} \\
 0
 \end{array}$$

Now

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Now multiply the Arch-Line ADB, by $\frac{1}{4}$ of the whole Diameter DF, the Product is the superficial Content of the Sector. See the following Example.

	55.552	Arch-Line ADB
	15	One Fourth of FD
(N ^o . 126.)	277 760	
	555 52	
	833.280	Superficial Content of Sector ADBE

Now measure the Angle of ABE, and subtract the Content from that of the Sector ADBE, the Remainder is the Measure of the Segment required; first consider the whole Diameter FD is 60, its $\frac{1}{2}$ DE is 30, from which subtract CD 12, and 18 remains for CE. See the following Examples.

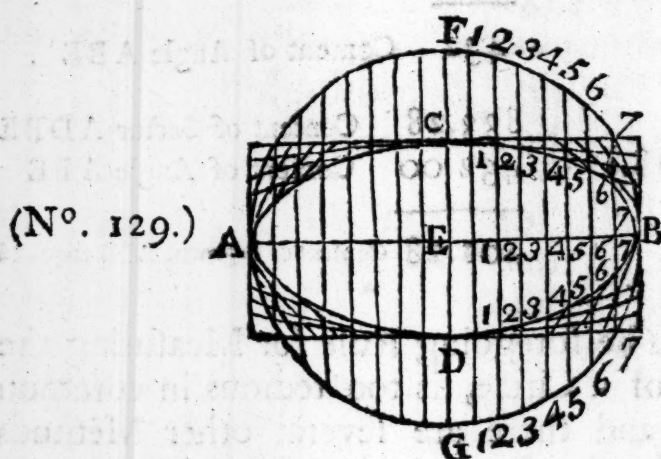
	48	Gord-Line AB
(N ^o . 127.)	9	Half the Versed Sine CE
	432	Content of Angle ABE
	833.28	Content of Sector ADBE
(N ^o . 128.)	432.00	Content of Angle ABE
	401.28	Content of Segment ADB required

N. B. The foregoing Rule for Measuring the Segment of a Circle, is too tedious in common Practice, and there are several other Methods adapted for that Purpose; in curious Marble, &c. it's proper to measure to the greatest Exactness, which

88 ARITHMETICK, &c. Improv'd.

which may be done thus: See (N^o. 120.) Describe the Sector ADBE, and find its superficial Content; then take the Length of the Arch by a Line, and proceed as in (N^{os}. 126, 127 and 128;) but in gross Materials, multiply the Cord or Base by $\frac{2}{3}$ of the Versed Sine or Perpendicular, its Difference from Truth being of no material Value.

To find the superficial Content of an Ellipsis or Oval, see (N^o. 129.) which is a Circle with 2 Ovals inscribed therein of equal Diameters, but different Curves; the innermost may be call'd the mathematical Ellipsis, because its two Diameters multiplied into each other, bears the same Proportion to its Area, as the Square of the Circle's Diameter does to its Area: The outward Curve is described by the Intersection of Lines, or by the Trammel, and sometimes by a Line and Pins; but all these make the same Curve and is quicker in the Hanches than the former, which makes a Difference in the Measurement



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To know the superficial Content of the inward Ellipsis, let the transverse Diameter AB be 36, and the conjugate Diameter CD 18; multiply the one into the other, and their Product by 11, and divide by 14, gives the Content required. See the following Example and (N^o. 106.)

36 Transverse Diameter AB
18 Conjugate Diameter CD

—
288
36
—

648 Product
11
—



(N^o. 130.) 648
—

14)7128(509.14 Content required

70..
128
126
—

20 Add a Cypher
14
—

60 Add a Cypher
56
—
4

Or thus by a given Decimal. See the following Example and (N^o. 111.)

N

36

98 ARITHMETICK, &c. Improv'd.

	36	Transverse Diameter AB
	18	Conjugate Diameter CD
	288	
	36	
	648	
(N ^o . 131.)	7857	Decimal
	4536	
	3240	
	5184	
	4536	
	509.1336	Content required

Demonstration. See the inward Ellipsis in (N^o. 129.) Because the Circle AFBG is divided into equally distant parallel Lines, and the conjugate Diameter of the Oval, is equal to half the Diameter FG of the Circle, and GD, DE, EC and CF are equal, so is 1 to 1, 2 to 2, 3 to 3, and so on; therefore, the inward Oval must be equal to half the Circle, and bear the same Proportion to AB, and CD multiplied into each other, as the Circle does to the Square of its Diameter.

N. B. See the outside Curve (N^o. 129.) I have measured several Sizes of these practical Ovals, and find their superficial Content to be near $\frac{1}{10}$ Part more than a mathematical Oval of the same Diameters; therefore I think it the best Rule to measure them as such, and add $\frac{1}{10}$ Part of the Product to itself; otherwise it will be so much less than its real Measure. To

ARITHMETICK, &c. Improv'd. 91

To find the superficial Content of the Face of a Globe: Multiply the Circumference by the Diameter, the Product is the Measure required.

To know the superficial Content of a Globe, whose Diameter is 20. — See the following Example.

First, Find the Circumference.



$$\begin{array}{r} 7 \overline{) 440} \quad 62.857 \text{ Circumference} \\ 42 \end{array}$$

(N^o. 132.)

$$\begin{array}{r} 20 \\ 14 \end{array}$$

$$\begin{array}{r} 60 \\ + 56 \end{array} \quad \text{Add a Cypher}$$

$$\begin{array}{r} 40 \\ 35 \end{array} \quad \text{Add a Cypher}$$

$$\begin{array}{r} 50 \\ 49 \end{array} \quad \text{Add a Cypher}$$

$$\begin{array}{r} 62.857 \text{ Circumference} \\ 20 \text{ Diameter} \end{array}$$

(N^o. 133.)

$$1257.140 \text{ Superficial Content required}$$

N 2

To

92 ARITHMETICK, &c. Improv'd.

To know the superficial Content of a Globe, whose Diameter is 24 Inches. See the following Example.

$$7 = 22 = 24$$

24

—

88

44

—

7)528(75.428 Circumference

49

—

38

35

—

30

28

—

20

14

—

60

56

—

4

Add a Cypher

Add a Cypher

Add a Cypher

75.428

24

Circumference

Diameter

301 712

1508 56

—

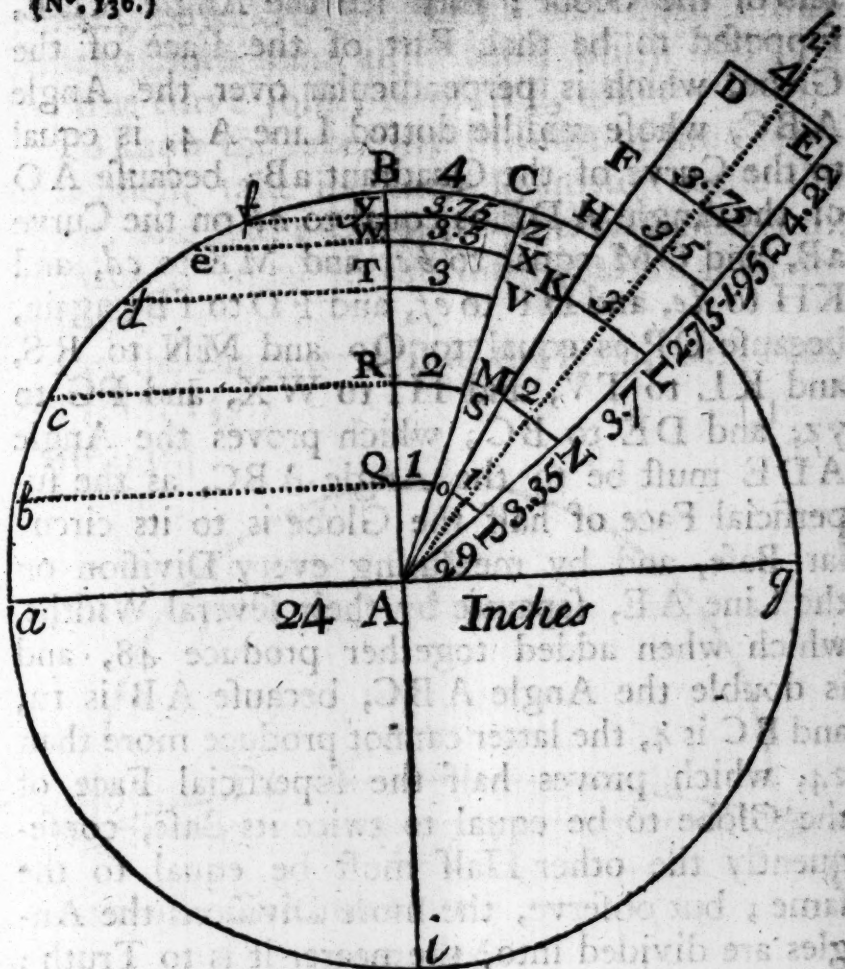
1810.272

Superficial Content required

(N^o. 135.)

Demonstra-

(N^o. 136.)



Demonstration. See (N^o. 136.) This Figure proves the Face of a Globe to be equal to 4 times the Area of a Circle of the same Diameter, *ag* is 24 Inches, and the Semi-Diameter *AB* is divided into 4 equal Parts at *QRT*, and *TB* is subdivided by *w*, and *wB* by *y*; the dotted Lines are perpendicular from *AB* to the Quadrant *aB*, which gives the several Divisions for the Angle *ADE*. See the Angle *ABC* with its Divisions, supposed to be drawn on the Circle or Base of one of the Semi-Diameters

ters of the Globe; then see the Angle ADE , supposed to be that Part of the Face of the Globe, which is perpendicular over the Angle ABC , whose middle dotted Line $A4$, is equal to the Curve of the Quadrant aB ; because AO of the Angle ADE is equal to ab on the Curve aB , and OM equal to bc , and MK to cd , and KH to de , and HF to ef , and FD to fB ; again, because OP is equal to Qo and MN to RS , and KL to TV , and HI to WX , and FG to yz , and DE to BC ; which proves the Angle ADE must be to the Angle ABC , as the superficial Face of half the Globe is to its circular Base, and by measuring every Division on the Line AE , separate by their several Widths, which when added together produce 48, and is double the Angle ABC , because AB is 12, and BC is 4, the latter cannot produce more than 24, which proves half the superficial Face of the Globe to be equal to twice its Base, consequently the other Half must be equal to the same; but observe, the more Divisions the Angles are divided into, the nearer it is to Truth; because, the Face of a Globe is made up of an infinite Number of Circles, whose Axis is their Center, therefore cannot be demonstrated to Perfection, no more than the Circle can be squared by its infinite Number of Angles; yet they answer as near Truth as Men can devise.

N.B. (N^o. 136.) gives the Lines for the covering a Globe, or Nich with any of the usual Materials; and the Angles may be of any Size, so they are divided in the same Proportion to each other; but observe to make true Joints by tacking in a Nail or Pin in every Point of the Divisions,

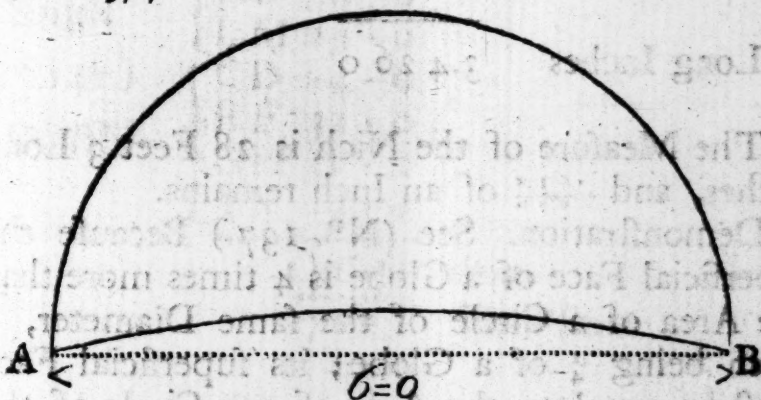
ARITHMETICK, &c. Improv'd. 95

vifions, as in A O M K H F D, and bend a thin Rule to touch them all at once, which will give the true curve Joint; fo of A E, &c.

To know the superficial Measure of the Crown of a Nich, take its whole Diameter across the Front, and find a Circle proportionable thereto; its Area is equal to the superficial Measure required.

Let the Diameter A B of the Nich, be 6 Feet. See (N^o. 137.)

(N^o. 137.)



Find the Circumference

$$7 \times 22 = 6$$

$$\underline{6}$$

$$7 \overline{) 132} (18.857 \text{ Circumference}$$

$$\underline{7}$$

$$62$$

(N^o. 138.)

$$\underline{56}$$

$$60$$

Add a Cypher

$$\underline{56}$$

$$40$$

Add a Cypher

$$\underline{35}$$

$$50$$

Add a Cypher

$$\underline{49}$$

$$1$$

18.857

96 ARITHMETICK, &c. Improv'd.

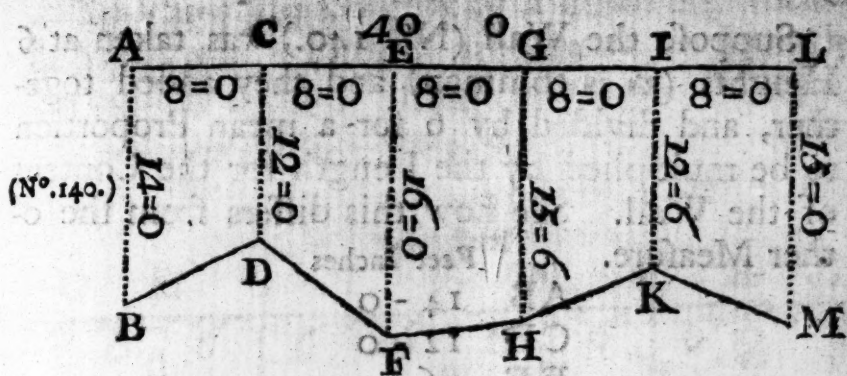
	18.857	Circumference
	1.5	One 4th of Diameter
	9 4 28 5	
(N ^o . 139.)	18 8 57	
Feet	28.2 85 5	
	1 2	Inches in a Foot
	5 71 0	
	2 8 55	
Long Inches	3.4 26 0	

The Measure of the Nich is 28 Feet 3 Long Inches, and $\frac{4}{10}$ of an Inch remains.

Demonstration. See (N^o. 137.) Because the superficial Face of a Globe is 4 times more than the Area of a Circle of the same Diameter, a Nich being $\frac{1}{4}$ of a Globe; its superficial Face must be equal to the Area of one Circle of the same Diameter.

To find the superficial Content of a Wall 40 Feet long, in which are 6 different Heights at equal Distance to each other; to the single Height of the two outside Lines AB, and LM add double that of the inside Lines CD, EF, GH, IK, and multiply half their Sum by one Space, the Product is the Content required. See (N^o. 140.) and the following Example.

(N^o. 140.)



	Feet	
Single	{ AB 14 - 0	
	{ LM 15 - 0	
(N°. 141.)	{ CD 24 - 0	
Double	{ EF 32 - 0	
	{ GH 31 - 0	
	{ IK 25 - 0	
	141 - 0	Sum
	70 - 6	Half Sum
	8 - 0	
Feet	564 - 0	Content of whole Wall

Demonstration. The two outside Lines AB, and LM are set down single, because they each represent but one Side of a Space; but those in the Middle each represents two; they are halved, because all superficial Planes which have two parallel Sides of unequal Lengths, are added together, and their Half is the true Mean to multiply by the Width, whose Product is the true superficial Content.

Suppose

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Suppose the Wall (N^o. 140.) was taken at 6 Heights (as is common) and they added together, and divided by 6 for a mean Proportion to be multiplied by the Length for the Content of the Wall. See how this differs from the other Measure.

	Feet	Inches
AB	14	0
CD	12	0
EF	16	0
GH	15	6
IK	12	6
LM	15	0

(N^o. 142.)

6)85 - 0 (14.16 Mean Height

6

—

25

24

—

10

6

—

40

36

—

4

14.16 Mean Height

(N^o. 143.)

40 Length

566.40 Content

This last Example differs 2 Feet, and almost 6 Inches from Truth, and the more unequal the Heights are the more it makes the Content.

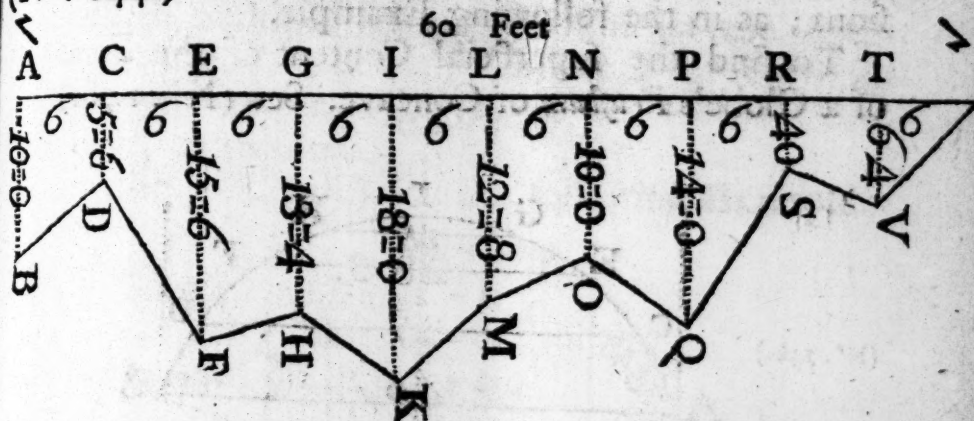
To

(N^o. 140.)
A
6
10
B

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To know the Content of a Plane Superficies, or Wall, whose Heights are unequal in Length, but equally distant from each other. See (N^o. 144.) and the following Example.

(N^o. 144.)



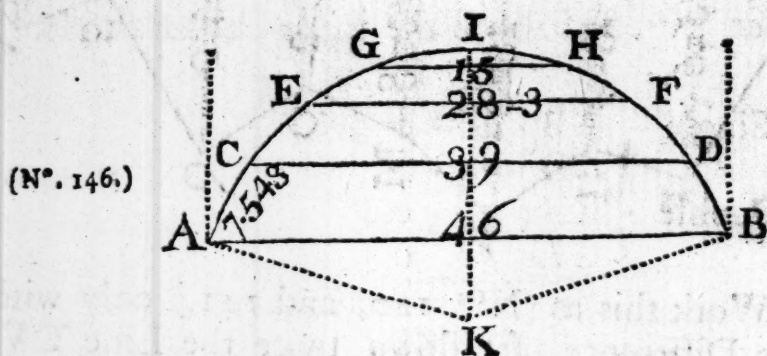
Work this as (N^{os}. 140, and 141.) only with this Difference, set down twice the Line TV, because there is an Angle without; otherwise the Measure of that Angle will be lost.

Single	AB	10 - 0	
	CD	11 - 0	
	EF	31 - 0	
(N ^o . 145.)	GH	26 - 8	
	IK	36 - 0	
Double	LM	25 - 4	
	NO	20 - 0	
	PQ	28 - 0	
	RS	8 - 0	
	TV	12 - 8	
		208 - 8	Sum
		104 - 4	Half Sum
		6 - 0	Width of AC, &c.
		626 - 0	Content required
		O 2	N.B.

100 ARITHMETICK, &c. Improv'd.

N.B. (N^{os}. 140 and 144) are not only set down as Examples to take the different Heights of Walls, &c. but as an Introduction of this Method in the measuring the superficial Faces of several Kinds of Convex and Concave Dimensions; as in the following Example.

To find the superficial Content of the Face of a Globe's *Frustum* or Concave. See (N^o. 146.)



Divide the Arch AI and BI into any Number of equal Parts, the more the truer the Work (for Reasons laid down in the Demonstrations of (N^o. 136.) from whence draw strait Lines, as AB, CD, EF and GH, and measure their several Diameters as in this Example, which may be done in a Concave or Inside of a Dome; but if the Dimension be a Convex, or Outside of a large Globe or Dome, &c. it may be proper to erect Perpendiculars, as from A and B, from whence measure to the Divisions as C and D, and subtract them from the great Diameter AB, the Remainder is the Line CD; and so of the other Divisions, when the Lengths of all the Diameters are known: Consider the Rules laid down in (N^{os}. 144 and 145.) then set down the
single

ARITHMETICK, &c. Improv'd. 101

single Length of the Diameter AB, and twice the Lengths of CD, EF and GH, and halve their Sum; then suppose the half Sum of the Diameters to be the Diameter of one Circle, and find a Circumference proportionable thereto, which multiply by one Division on the Archline as AC, &c. their Product is the superficial Content of the Frustum of a Globe or Concave, as required.

See (N^o. 146.) and the following Example.

		Feet	Inches	
Single	AB	46	- 0	
Double	{ CD	78	- 0	
	{ EF	56	- 6	
	{ GH	30	- 0	
		<u>210</u>	- 6	Sum
7 = 22 =		105.25		Half Sum
		22		
		<u>21050</u>		
		21050		
(N ^o . 147.)	7)2315.50	(330.78		Circumference
	21	00		
	—			
	21			
	—			
	055			
	49			
	—			
	60			
	56			
	—			
	4			
				330.78

102 ARITHMETICK, &c. Improv'd.

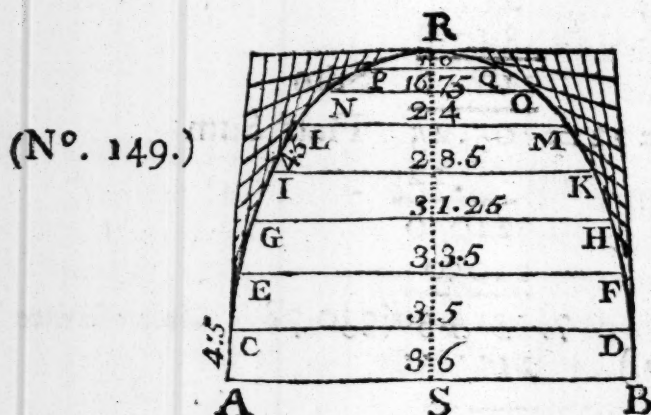
330.78 Circumf. brought down
 7.543 Division AC
 ----- (N^o. 146.)

(N^o. 148.)

99234
 132312
 165390
 231546

2495.07 3 54 Superficial Content required

To find the superficial Content of an Ovalar Convex, or Concave Dome. See (N^o. 149.)



Divide the Curves AR and BR into any Number of equal Parts, the more the better, and find the Diameters as in the foregoing Example ; then set down the Length of the Line AB single, and all the other double, and halve their Sum, and find a Circumference proportionable thereto, which multiply by one of the Divisions on the Curve as AC, their Product is the superficial Content required.

Single

ARITHMETICK, &c. Improv'd. 103

(N ^o . 150.)	Single	AB	36
		CD	70
		EF	67
		GH	62.5
Double		IK	57
		LM	48
		NO	33.5
		PQ	20

394 Sum

7 = 22 = 197 Half Sum
22

394

394

7)4334(619 Circumference
42..

13

7

64

63

1 Remains

619 Circumference

4.5 Division A C

(N^o. 149.)

(N^o. 151.)

309.5

2476

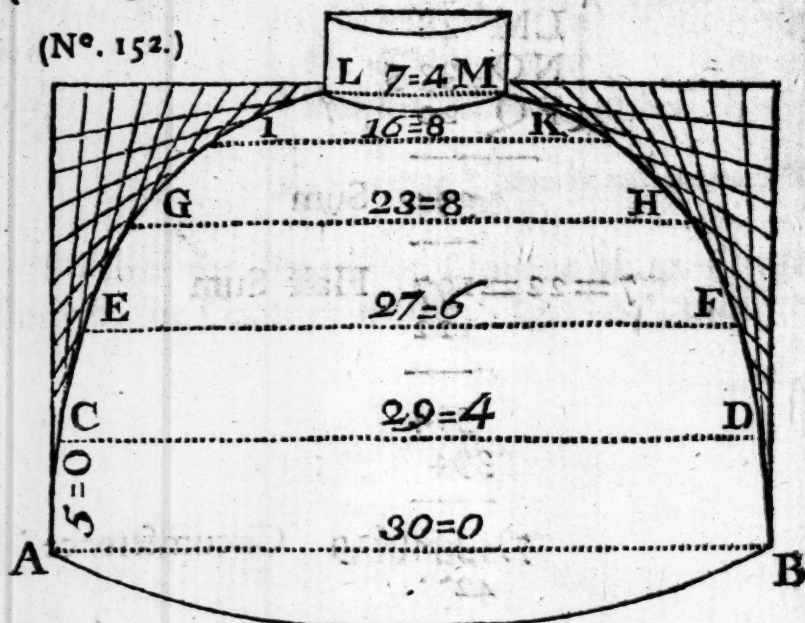
2785.5 Content required

To

104 ARITHMETICK, &c. Improv'd.

To find the superficial Content of the Convex or Concave Face of a Dome, there being a Cupola or Well-hole on the Crown, not intended to be measured in this Dimension. See (N^o. 152.)

(N^o. 152.)



Divide the Curves AL and BM into any Number of equal Parts, as AC, CE, EG, GI, and IL; also, as BD, DF, FH, HK and KM, and measure their several Diameters as represented by the dotted Lines; then see (N^o. 140, and 141) where the two outside Lines are set down single, for which Reason set down the Diameters AB and LM single, and all the other double, and halve their Sum, which suppose to be the Diameter of a Circle; then find a Circumference proportionable thereto, which multiply by one of the Divisions on the Curves as AC, their Product is the superficial Content required.

Single

		Feet	Inches	
Single	LM	7	- 4	
Double (N ^o . 153.)	IK	33	- 4	
	GH	47	- 4	
	EF	55	- 0	
	CD	58	- 8	
Single	AB	30	- 0	
		231	- 8	Sum
		115	- 10	Half Sum

7 = 22 = 115.833 Decimal of 10 Inches

22

231 666

2316 66

7)2548.326(364.046 Circumference
21... 5 AC (N^o. 152.)

(N^o. 154.)

44 | Feet 1820.230 Content

42 | 12

28 260

28 230

032 | Inches 2.560

28

46

42

4

P

N.B.

N. B. The foregoing Rules beginning at (N^o. 140.) commands all flat Superficies either strait-lined or curv'd; where there are no large Angles or Curves between the Extents of the equal distant parallel Lines (as between BD or DF, &c. in N^o. 140.) because it brings the whole Dimension into one Parallelogram, whose Length is proportionable to all the equal distant Lines, and its Width to one of the Divisions; again, see (N^o. 146.) which is supposed to be the Frustum of a Globe or Concave, the Arch AIB is its middle Section, which is the Segment of a Circle, whose Measure may be shew'd by the same Rule. Thus, multiply the half Sum 105.25 by the Width 7.543 AC, their Product is the superficial Content of the Segment AIB (and so of the two following Sections N^{os}. 149 and 152 and all other Curves.) But to return to the superficial Measure of the Globe or Concave: The half Sum 105.25 is supposed to be the Diameter of a Circle, whose Circumference is found proportionable thereto, which is 330.78, and is the Length of a Parallelogram when multiplied by the Width 7.543 AC, the Product is the superficial Content of the Frustum required; it may not be well understood by some, why the half Sum being made the Diameter of a Circle should give a Circumference proportionable to the Length of a Parallelogram, which shall give the true Content required: For Example, see (N^o. 146.) and find the different Lengths for the 3 Parallelograms and Crown, which make 4 Diameters of Circles, and find their several Circumferences, which must be equal to that of the half Sum. See the following Examples.

ARITHMETICK, &c. Improv'd. 107

AB 46
CD 39

85

First Diameter 42.5

7 = 22 = 42.5
2 2

850
850

(N^o. 155.)

7)935.0(133.571 1st Circumference

7

23

21

25

24

40

35

50

49

10

3

P 2

CD

108 ARITHMETICK, &c. Improv'd.

CD 39
EF 28

67

33.5 Half Sum

7 = 22 = 33.5
2 2

670
670

(N^o. 156.)

7)737.0(105.285 2d Circumference
7 0 0

037
35

20
14

60
56

40
35

5

EF

ARITHMETICK, &c. Improv'd. 109

EF 28
GH 15

43

21.5 Half Sum

7 = 22 = 21.5

22

(N^o. 157.)

430

430

7)473.0(67.571 3d Circumference

42

53

49

40

35

50

49

10

7

3

GH

110 ARITHMETICK, &c. Improv'd:

GH 15

7.5 Half Sum

$$7 = 22 = 7.5$$

2 2



(N^o. 158.)

$$\begin{array}{r|l} 150 & 133.571 \\ 150 & 105.285 \\ \hline & 67.571 \\ 7)165.0 & 23.571 \\ \hline 14 & \end{array} \left. \vphantom{\begin{array}{r|l} 150 & 133.571 \\ 150 & 105.285 \\ \hline & 67.571 \\ 7)165.0 & 23.571 \\ \hline 14 & \end{array}} \right\} 4 \text{ Circumf.}$$

329.998 See (N^o. 147.)

25

21

40

35

50

49

10

7

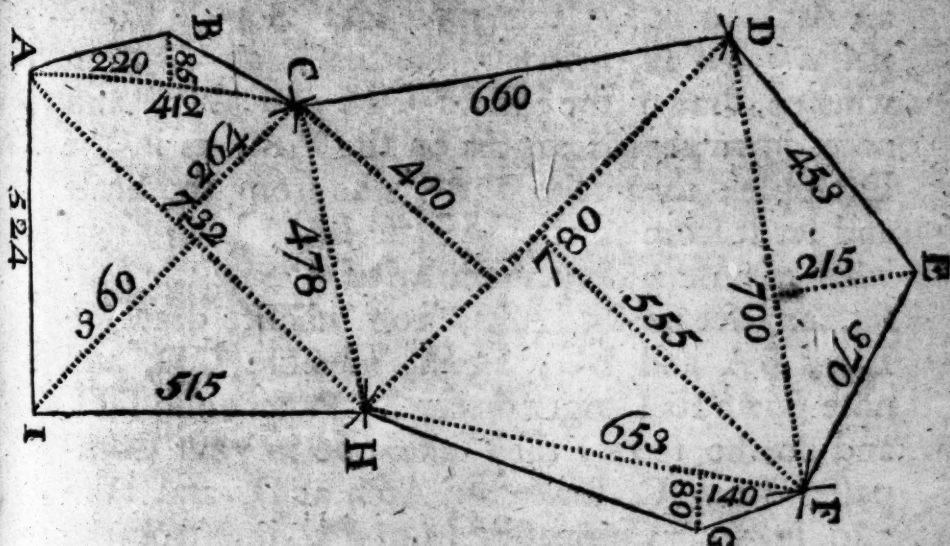
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N. B. There is a small Difference between the Circumference (N^o. 147.) and this in (N^o. 158.) which is occasioned by the Remainder of Decimals in these last Examples.

To take the Plan of a Piece of Ground, by the Chain only, and cast up the Measurement by Links. See (N^o. 159.)

(N^o. 159.)

(N^o. 159.)



Observe to begin with the first Angle at I, and measure to A which is 524 Links; take that Number from the Scale, and draw the Line IA; then observe which is the next Point to make the Angle, (see H,) measure AH, and take its Length from the Scale in your Compasses; with one Foot in A strike an Arch at Pleasure towards the Point H; then measure HI, and take the Length in your Compasses; with one Foot in I, strike an Arch to intersect the Arch at H, from whence draw the Lines HA and HI, and note down their Lengths on the Plan, as in this Example. Stand at A and let your Assistant hold a Staff upright opposite B, and direct him to move it in a Line with AC, and there stick it down and measure AC, which note down on a By-Paper; also, note down the Distance from A to the Staff and the Depth of the off-set Measure CH, and note down its Length on your By-Paper; then

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then having the two Lengths noted down, take 478 in your Compasses, with one Foot H, strike an Arch as at C; then take 412 in your Compasses from A, intersect the Arch at C, from whence drawn the Lines CH and CA, and note down their Lengths on the Plan, as in the Example; then take 220 Links from the Scale and set it from A on the Line towards C, from whence raise a Perpendicular to denote the Off-set, and set on 85 Links, from whence draw the Lines BA and BC; again, measure CD, and note down its Length on the By-Paper; also DH, and do the same; then take 660 in your Compasses from C, strike an Arch at D, and take 780 in your Compasses from H, intersect the Arch at D, from whence draw the Lines DC and DH, and note down their Lengths on the Plan as in the Example; then measure DF and FH, and note down their Lengths in the By-Paper; also take 700 and from D strike an Arch at F; then take 653 and from H intersect the Arch at F, from whence draw the Lines FD and FH, and note down their Lengths on the Plan; then stand at F and let your Assistant hold a Staff upright opposite G, and direct him to set it in a Line with FH, and there stick it down; then measure from F to the Staff, which proves 140, and from the Staff measure the Depth of the Off-set which is 80, note them both down in your By-Paper; then take 140, and set it from F on the Line towards H, from whence raise a Perpendicular to G, set on 80 from the Staff towards G, and draw the Lines FG and GH; again, measure DE and EF, and
note

note down their Lengths as before ; then take 370, and from F strike an Arch at E and take 453, and from D intersect the Arch at E; draw the Lines ED and EF, and note down their Lengths on the Plan: Now the Angles are taken, let fall a Perpendicular to the Base from every Point, and measure their Lengths by the Scale on the Plan, and note them down as in the Example.

Cast up the several Angles thus: Multiply their Base by $\frac{1}{2}$ their Perpendicular, as demonstrated by (N^o. 99.) and observe where two Angles have one Base, multiply that Base by half the Length of the two Perpendiculars, their Product gives the Content of both Angles in one Sum. See the following Examples.

AH	739	Base
IC	312	Half Perpendiculars

1478
739
2217

230568 Content of ACHI

AC	412	Base
B	42.5	Half Perpendiculars

(N^o. 160.) 2060
824
1648

17510.0 Content of ABC

Q

HD

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HD 780 Base
CF 477.5 Half Perpendiculars

3900
5460
5460
3120

372450.0 Content of CDFH

HF 653 Base
G 40 Half Perpendiculars

(N°. 160.) 26120 Content of HGF

DF 700 Base
E 107.5 Half Perpendicular

3500
4900
7000
75250.0

230568
17510
372450
26120
75250

Square Links

(N°. 161.)

Acres

7)21898
4

Roods in an Acre

No Roods

87592
40

Perch in a Rood

Perch

35)03680

The

ARITHMETICK, &c. Improv'd. 115

The Content of (N^o. 159.) is 7 Acres, no Roods, 35 Perch, and $1\frac{3333}{10000}$ remains.

Observe, When the Dimensions are squared they produce square Links, which are added all together in one Sum to throw them into Acres, 5 Figures to the Right must be cut off, and all that remains to the Left are so many Acres; because an Acre contains 100,000 square Links, therefore the 1 must be equal to an Acre; again, the Remainder is multiplied by 4, because an Acre contains 4 Roods, therefore 5 Figures to the Right are cut off, and those to the Left are Roods; again, the second Remainder is multiplied by 40, because a Rood contains 40 Perch, cut off 5 Figures to the Right, and all those to the Left are Perch, the Remainder is so many of 100,000 of a Perch, not worth farther Notice.

To throw any given Number in Length of Chains and Links, into Feet by a given Decimal, provided the Links be according to the Statute of *England*, which are 25 to 16 Feet 6 Inches. The Chain is generally made 4 Perch long equal to 66 Feet, and is divided into 100 Links, each Link is 7.92 Inches.

To know how many Feet in Length, is contain'd in 67451 Links of *Gunter's* Chain.

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(N ^o . 162.)	674 51	Links
	.66	Decimal
	<u>4047 06</u>	
	40470 6	
Feet	44517.66	
	12	Inches in a Foot
	<u>132</u>	
	66	
	<u>7.92</u>	
Inches	4	Quarters in an Inch
	<u>3.68</u>	
Quarters		

The Sum is 44517 Feet 7 Inches and $\frac{3}{4}$, and $\frac{5}{16}$ of a Quarter of an Inch remains.

To know how many Feet in Length is contain'd in 999 Links of *Gunter's Chain*.

(N ^o . 163.)	999	Links
	.66	Decimal
	<u>59 94</u>	
	599 4	
Feet	659.34	
	12	Inches in a Foot
	<u>68</u>	
	34	
	<u>4.08</u>	
Inches	4	Quarters in an Inch
	<u>32</u>	

The

ARITHMETICK, &c. Improv'd. 117

The Sum is 659 Feet 4 Inches, and $\frac{1}{4}$ of a Quarter of an Inch.

To prove the Decimal .66. See how many Feet is contained in 100 Links of *Gunter's* Chain.

	100	Links
	.66	Decimal
(N ^o . 164.)	<u>600</u>	
	600	
Feet	66.00	Proof because 100 Links is equal to 66 Feet

To prove a Link of *Gunter's* Chain to be 7.92 Inches, multiply the one Link by 25 Links, and divide by 12 Inches, the Quotient will be 16 Feet 6 Inches.

	7.92	One Link
	25	Links
(N ^o . 165.)	<u>3960</u>	
	1584	
	12)198.00	(16=6 Equal to 25 Links
	<u>12</u>	
	78	
	<u>72</u>	
	6	Inches

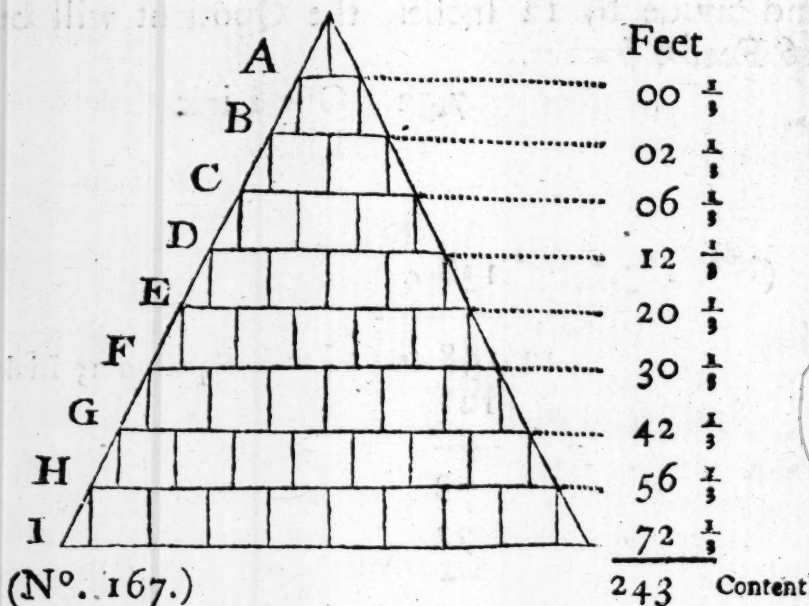
To find the solid Content of a Pyramid 9 Feet square at Base, and the same Altitude.
Multiply

IV 81 ARITHMETICK, &c. Improv'd.

Multiply the Area of the Base by $\frac{1}{3}$ of the Altitude, their Product is the Content required. See the following Example.

	9	} Feet
	9	
(N ^o . 166.)	81	Product of Base
	3	One Third of Altitude
	243	Solid Content

Demonstration. See (N^o. 167.) which proves a Pyramid to be equal to $\frac{1}{3}$ of a Parallelopipedon or Cube, whose Ends and Length is equal to the Base and Altitude of the Pyramid.



This Figure is made up of 9 Courses of 1 Foot high each: The upper Course A contains 4 quarter Pyramids or 6 Inches Base equal to $\frac{1}{3}$ of a Foot Cube: The Course B contains 1 Cube Foot,

Foot, and 4 Wedges of 6 Inches Base equal to 1 Cube Foot, and 4 quarter Pyramids at the Angles of 6 Inches Base equal to $\frac{1}{3}$ of a Cube Foot, the Whole 2 Feet $\frac{1}{3}$: The Course C contains 4 Cube Feet and 8 Wedges equal to 2 Feet, and 4 quarter Pyramids equal to $\frac{1}{3}$ of a Foot, the Whole 6 Feet $\frac{1}{3}$: The Course D contains 9 Cube Feet and 12 Wedges equal to 3 Feet, and 4 quarter Pyramids equal to $\frac{1}{3}$ of a Foot, the Whole 12 Feet $\frac{1}{3}$: The Course E contains 16 Cube Feet and 16 Wedges equal to 4 Cube Feet, and 4 quarter Pyramids equal to $\frac{1}{3}$ of a Foot, the Whole 20 Feet $\frac{1}{3}$: The Course F contains 25 Cube Feet and 20 Wedges equal to 5 Feet, and 4 quarter Pyramids equal to $\frac{1}{3}$ of a Foot, the Whole 30 Feet $\frac{1}{3}$: The Course G contains 36 Cube Feet and 24 Wedges equal to 6 Feet, and 4 quarter Pyramids in the Angles equal to $\frac{1}{3}$ of a Foot, the Whole 42 Feet $\frac{1}{3}$: The Course H contains 49 Cube Feet and 28 Wedges equal to 7 Feet, and 4 quarter Pyramids equal to $\frac{1}{3}$ of a Foot, the Whole 56 Feet $\frac{1}{3}$: The Course I contains 64 Cube Feet and 32 Wedges equal to 8 Feet, and 4 quarter Pyramids in the Angles equal to $\frac{1}{3}$ of a Foot, the Whole 72 Feet $\frac{1}{3}$. See the Table in (N^o. 167.) which shews the whole Content of the Pyramid equal to (N^o. 166.)

To prove by Figures a Pyramid to be $\frac{1}{3}$ of a Cube, whose Sides are equal to the Base and Altitude of the same. See (N^o. 166 and 167.) and the following Example.

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$$\begin{array}{r}
 9 \} \text{ Feet} \\
 9 \\
 \hline
 81 \text{ Equal to Base} \\
 9 \\
 \hline
 \text{(N}^\circ. 168.) \quad 729 \text{ Product of Cube} \\
 \hline
 3)729(243 \text{ Proof} \\
 6 \\
 \hline
 12 \\
 12 \\
 \hline
 09 \\
 9 \\
 \hline
 0
 \end{array}$$

To know the solid Content of the Frustum of a Pyramid, 9 Feet square at the greater Base, and 3 Feet square at the lesser Base, and its Altitude 6 Feet.

Observe, To the greater Side AB, add half the lesser Side CD, multiply their Sum by the greater Side AB; again, to the lesser Side CD, add half the greater Side AB, multiply their Sum by the lesser Side CD; then add the Products together, and multiply their Sum by $\frac{1}{3}$ of the Altitude gives the Content required. See the following Example.

ARITHMETICK, &c. Improv'd. 121

$$\begin{array}{r}
 3 \quad \text{CD} \\
 4.5 \quad \text{Half AB} \\
 \hline
 7.5 \quad \text{Sum} \\
 3 \quad \text{CD} \\
 \hline
 22.5 \quad \text{Product} \\
 \hline
 9 \quad \text{AB} \\
 1.5 \quad \text{Half CD} \\
 \hline
 10.5 \quad \text{Sum} \\
 9 \quad \text{AB} \\
 \hline
 94.5 \quad \text{Product} \\
 22.5 \quad \text{Product} \\
 \hline
 117.0 \quad \text{Sum} \\
 2 \quad \text{One 3d of Altitude} \\
 \hline
 234 \quad \text{Content required}
 \end{array}$$

(N^o. 169.)

Or thus : Multiply the Side of the greater End AB, by the Side of the lesser End CD, and add the Product to the Areas of both Ends. See the following Example.

$$\begin{array}{r}
 9 \quad \text{AB} \\
 3 \quad \text{CD} \\
 \hline
 27 \quad \text{Product} \\
 \hline
 81 \quad \text{Area of AB} \\
 9 \quad \text{Area of CD} \\
 27 \quad \text{Product of AB, CD} \\
 \hline
 117 \quad \text{Sum} \\
 2 \quad \text{One 3d of Altitude} \\
 \hline
 234 \quad \text{Content required}
 \end{array}$$

(N^o. 170.)

R

Or

122 ARITHMETICK, &c. Improv'd.

Or thus: Multiply the Areas of both Ends into each other, and extract the square Root of their Product; then to the two Areas add the Root, and multiply their Sum by $\frac{1}{3}$ of the Altitude, the Product is the Content required. See the following Example.

81 Area of AB

9 Area of CD

—

2)729(27 Root

4

—

47)329

329

—

0

81 Area of AB

9 Area of CD

(N°. 171.)

27 Root

—

117 Sum

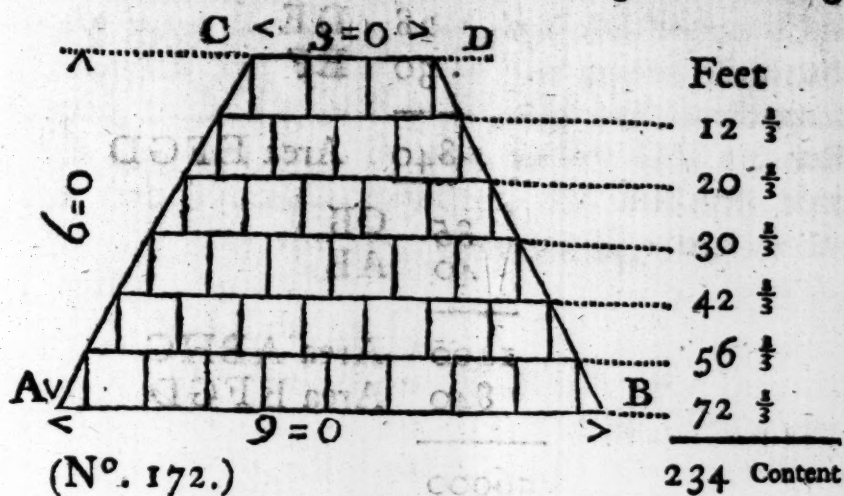
2 One Third of Altitude

—

234 Content required

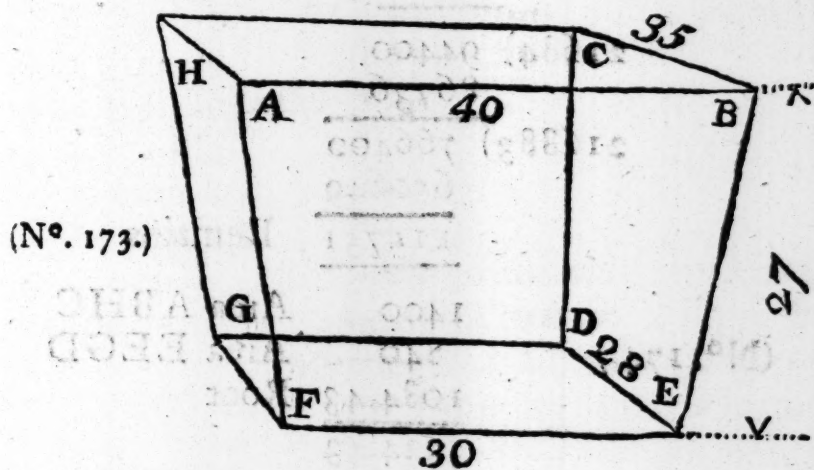
For Demonstration of the Truth of the three foregoing Rules, see (N°. 172.) which is equal with the six lower Courses of (N°. 167.)

(N°. 172.)



See (N^o. 173.) Whose Top and Bottom are out of Proportion to each other.

To find its solid Content, multiply the Areas of the Top and Bottom into each other, and extract the square Root of their Product; then to their two Areas add the Root, and multiply their Sum by $\frac{1}{3}$ of the Altitude, the Product is the Content required. See (N^{os}. 173 and 174.)



124 ARITHMETICK, &c. Improv'd,

28 DE

30 EF

840 Area EFGD

35 CB

40 AB

1400 Area ABHC

840 Area EFGD

56000

11200

1)1176000(1084.43 Root

I

208)01760

1664

2164) 9600

8656

21684) 94400

86736

216883) 766400

650649

115751

Remains

1400

Area ABHC

840

Area EEGD

1084.43

Root

3324.43

9

One Third of Altitude

29919.87

Content required

Or

(N°. 174.)

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Or thus: To the Greater AB 40, add half the Lesser EF 15; multiply by the Greater CB 35; again, to the Lesser EF 30, add half the Greater AB 20, multiply by the Lesser DE 28, add the two Products together, and multiply their Sum by $\frac{1}{3}$ of the Altitude, the Product is the Content required.

See the following Example.

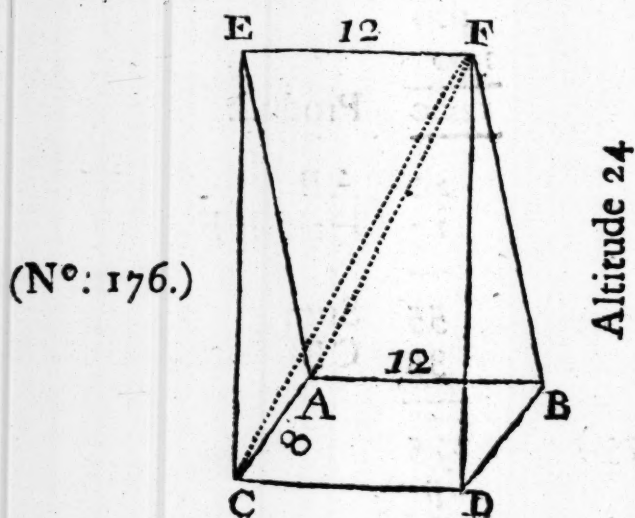
30	EF
20	Half AB
—	
50	Sum
28	DE
—	
400	
100	
<u>1400</u>	Product
40	AB
15	Half EF
—	
55	Sum
35	CB
—	
(N ^o . 175.) 275	
165	
—	
1925	Product
1400	Product
—	
3325	
9	One Third of Altitude
—	
29925	Content required

N.B.

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N. B. There is a small Difference of 5.13, in the two Contents, a Trifle in so large a Number ; the Reason is, because the Bottom and Top of the Object (N^o. 173.) are not proportionable to each other; but where they are so, and are Squares or Oblongs, I would recommend the foregoing Rule (N^o. 175.) otherwise, if they differ in Proportion, or are angular or curved, the Rule laid down in (N^o. 174.) is more preferable.

To find the solid Content of a Wedge, whose Side ACE, is parallel with the Side BDF, multiply the Area of the Heel by half the Altitude, gives the solid Content.



(N^o. 177.)

12	
8	
96	Area of Heel
12	Half Altitude
192	
96	
1152	Content required

See

ARITHMETICK, &c. Improv'd. 127

See (N^o. 176.) and observe the Cross-lines A F and C F, which suppose to be saw'd through, the one is a Pyramid, and the other in the Form of a Reel, with 2 sharp Edges at Right Angles. I have known such like Bodies, whose Measurement has been required in order to estimate their Weight, when they have been intended to be cast in Metal.

To know the solid Content of the Reel Piece A C E F. (See (N^o. 176.) multiply the one End by the other, and their Product by $\frac{1}{2}$ of the Altitudes or Length, the Product is the solid Content required.

	12	EF
	8	AC
	—	
(N ^o . 178.)	96	Sum
	4	One Sixth of Length
	—	
	384	Content required

Demonstration. See (N^o. 176.) which is a parallel Wedge, and consequently equal to half a Parallelopipedon or Cube, whose Ends and Length is equal to its Base and Altitude ; again consider the Pyramid A B C D F is equal to $\frac{1}{3}$ of the Parallelopipedon or Cube, (which is proved by N^o. 167.) of which the whole Wedge is equal to half, and the Pyramid must be equal to $\frac{2}{3}$ of the Wedge, and the Reel Piece A C E F, which remains equal to $\frac{1}{3}$ of the same ; and consequently equal to half the Pyramid, and $\frac{1}{6}$ of the Parallelopipedon or Cube, whose Ends and Length are equal to the Base and Altitude of the Wedge ; therefore all Pieces which are cut

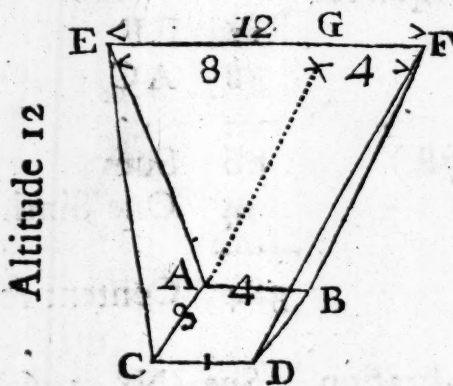
to

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to sharp Edges, at right Angles to each other, as ACEF, must be measured as (N^o. 178.)

To know the solid Content of a Wedge, whose Sides are not parallel, see (N^o. 179.) First, square the Heel ABCD, and multiply it by half the Akitude or Length EC, the Product is the solid Content of ABCDGF; then multiply AC by EG, and their Product by $\frac{1}{6}$ of the Altitude, the Product is the solid Content of ACEG; add the two Products together, and their Sum is the solid Content of ABCDEF required. See the following Example.

(N^o. 179.)



4	AB
3	AC
<u>12</u>	Sum
6	Half Altitude
<u>72</u>	Content of ABCDFG
8	EG
3	AC
<u>24</u>	Sum
2	One Sixth of Altitude
<u>48</u>	Content of ACEG
<u>72</u>	Content of ABCDFG
<u>120</u>	Content required

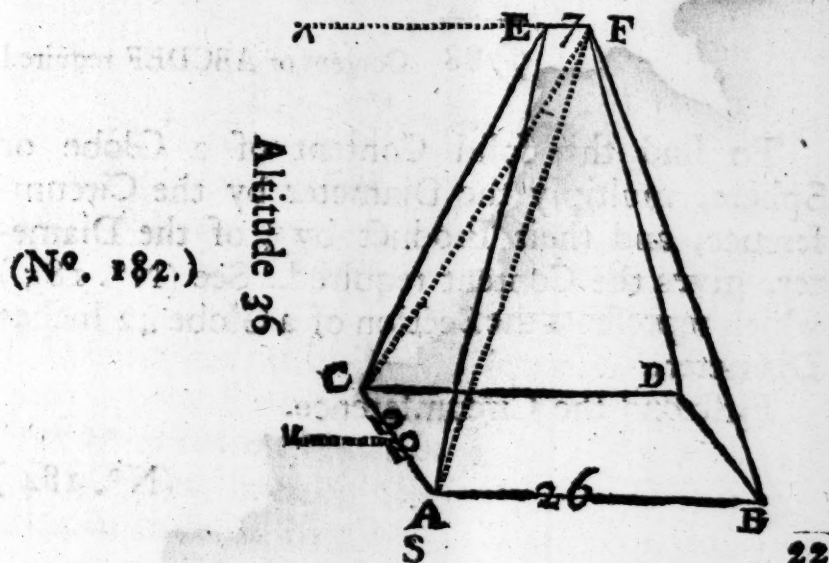
(N^o. 180.)

Or

Or thus : Measure ABCDF as a Pyramid, and E F A C as a Reel Piece, it produces the same.

	4	AB
	<u>3</u>	AC
	12	Sum
	<u>4</u>	One Third of Altitude
	48	Content of ABCDF
	12	EF
	<u>3</u>	AC
(N ^o . 181.)	36	
	<u>2</u>	One Sixth of Altitude
	72	Content of ACEF
	<u>48</u>	Content of ABCDF
	120	Content required

To know the solid Content of a double taper'd Wedge. See (N^o. 182.) First, measure ABCDF as a Pyramid ; then ACEF as a Reel Piece, and add their Products together, their Sum will be the Content required.



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	22	AC
	7	EF
(N ^o . 183.)	154	
	6	One 6th of Altitude
	924	Content of ACEF
	26	AB
	22	AC
	52	
	52	
	572	Content of Base
	12	One Third of Altitude
	1144	
	572	
	6864	Content of Pyramid
	924	Content of Reel Piece
	7788	Content of ABCDEF required

To find the solid Content of a Globe or Sphere, multiply the Diameter by the Circumference, and their Product by $\frac{1}{6}$ of the Diameter, gives the Content required. See (N^o. 185.) which represents the Section of a Globe 42 Inches Diameter.

First find the Circumference.

(N^o. 184.)

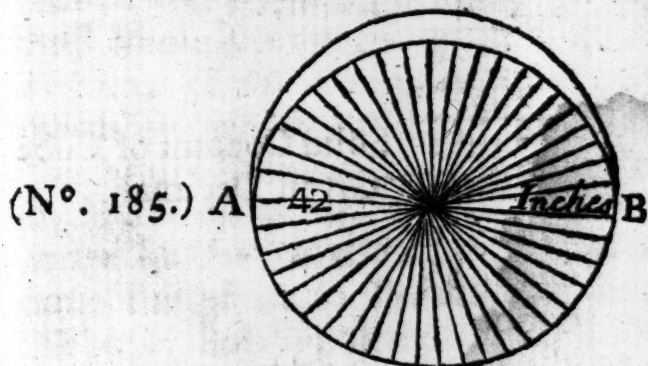
ARITHMETICK, &c. Improv'd. 131

(N^o. 184.)

$$\begin{array}{r}
 7 = 22 = 42 \text{ Diameter} \\
 \underline{22} \\
 84 \\
 \underline{84} \\
 7)924(132 \text{ Circumference} \\
 \underline{7} \\
 22 \\
 \underline{21} \\
 14 \\
 \underline{14} \\
 0
 \end{array}$$



$$\begin{array}{r}
 132 \text{ Circumference} \\
 \underline{42 \text{ Diameter}} \\
 264 \\
 \underline{528} \\
 5544 \text{ Superficial Content} \\
 \underline{7 \text{ One 6th of Diameter}} \\
 38808 \text{ Solid Content}
 \end{array}$$



Demonstration. The Circumference multiplied by the Diameter, is proved to produce the superficial Face of a Globe, by (N^{os}. 135 and 136.) again, because the Body of a Globe contains an infinite Number of Pyramids pointing

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to the Center, whose Base is the superficial Face of a Globe, and their Altitude is the Semi-Diameter, $\frac{1}{2}$ of which is the proportionable Number to be multiplied, with the Area of their Base, to give their solid Content, as proved by (N^{os}. 166 and 167.) Therefore $\frac{1}{2}$ of the Diameter multiplied by the superficial Face of the Globe, must be the solid Content.

To find the solid Content of a Globe by a given Decimal, multiply the Cube, whose Sides are equal to the Diameter of the Globe by .5238094, their Product is the Content required. See (N^o. 185.) and the following Example.

	42	} Diameters
	42	
	—	
	84	
	168	
	—	
	1764	
(N ^o . 186.)	42	Diameter
	3528	
	7056	
	—	
	74088	Solid Content of Cube
	.5238094	Given Decimal
	296352	
	666792	
	00000	
	59 2704	
	222 264	
	1481 76	
	37044 0	
	—	
	38807.9908272	Content required

N. B.

N. B. I calculated this Decimal from the following Reasons, because the solid Content of a Globe, is $\frac{2}{3}$ of that of a Cylinder of the same Diameter and Height: Let it be 42 Inches as in the foregoing Examples. Observe, it is proved, that the superficial Face of a Globe is the Base of an infinite Number of Pyramids contain'd therein, and that its Area is 4 times more than the Area of a Circle of the same Diameter; for which Reason I throw the Face of the Globe into one Circle, and imagine to have an infinite Number of Pyramids placed thereon, whose Altitude is 21 Inches equal to the Semi-Diameter of the Globe; then multiply the Area of that Circle by 7 Inches, it being $\frac{1}{3}$ of the Altitude of those imaginary Pyramids, the Product must be a Cylinder of 7 Inches high, whose solid Content is equal with the Globe; but its Area at the End, is 4 times more than a Circle whose Diameter is 42 Inches; therefore, I divide the Area of the Cylinder's End into 4 Circles, whose Diameters are each 42 Inches equal with that of the Globe, and set them one over the other, which makes a Cylinder of 28 Inches high; then consider what Part of 42 is 28, say $\frac{2}{3}$, which proves a Globe to be $\frac{2}{3}$ of a Cylinder of the same Diameter and Height, because this of 28 Inches high is equal with the Globe in Solidity and Diameter, and no more than $\frac{2}{3}$ of its Height.

The next Thing to be considered is to know, what Proportion a Cylinder of the same Height and Diameter bears to a Cube, whose Sides are equal to that and the Diameter of a Globe. See (N^{os}. 106

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(N^{os}. 106 and 107.) which is a Circle inscribed in a Square, whose Area is there proved to be $\frac{11}{14}$ of the Square, which Proportion the Body of the Cylinder bears to the Cube; because they bear the same Proportion from one End to the other, for which Reason the Decimal of the Cylinder must be found. Say, as 14 is to 100, so is 11 to the Decimal of the Cylinder. See the following Example.

$$14 = 100 = 11$$

$$\begin{array}{r} 11 \\ \hline 100 \end{array}$$

$$\begin{array}{r} 100 \\ \hline \end{array}$$

$$14 \overline{) 1100} (.7857142$$

$$\begin{array}{r} 98 \\ \hline \end{array}$$

$$\begin{array}{r} 120 \\ \hline \end{array}$$

$$\begin{array}{r} 112 \\ \hline \end{array}$$

$$\begin{array}{r} 80 \\ \hline \end{array}$$

$$\begin{array}{r} 70 \\ \hline \end{array}$$

$$\begin{array}{r} 100 \\ \hline \end{array}$$

$$\begin{array}{r} 98 \\ \hline \end{array}$$

$$\begin{array}{r} 20 \\ \hline \end{array}$$

$$\begin{array}{r} 14 \\ \hline \end{array}$$

$$\begin{array}{r} 60 \\ \hline \end{array}$$

$$\begin{array}{r} 56 \\ \hline \end{array}$$

$$\begin{array}{r} 40 \\ \hline \end{array}$$

$$\begin{array}{r} 28 \\ \hline \end{array}$$

$$\begin{array}{r} 12 \\ \hline \end{array}$$

A given Decimal
to find the Con-
tent of a Cylin-
der

Add a Cypher

Add a Cypher

Add a Cypher

Add a Cypher

Add a Cypher

Next

(N^o. 187.)

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Next find the Decimal of the Globe, because the solid Content of a Globe is $\frac{2}{3}$ of that of a Cylinder of the same Diameter and Height; say, as 3 is to the Decimal of the Cylinder, so is 2 to the Decimal of the Globe. See the following Example.

$$3 = 7857142 = 2$$

$$3)15714284(.5238094$$

$$15 \dots$$

$$07$$

$$6$$

$$11$$

(N^o. 188.)

$$9$$

$$24$$

$$24$$

$$028$$

$$27$$

$$14$$

$$12$$

$$2$$

A given Decimal
for the Measure-
ment of a Globe
See (N^o. 186.)

Let

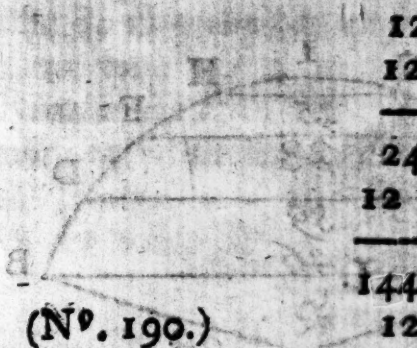
136 ARITHMETICK, &c. Improv'd.

Let a Cube of 12 Inches square be given to know the solid Content of a Cylinder of the same Height and Diameter. First, find the Inches in a Cube Foot, which multiply by the given Decimal. (See N^o. 187.) .7857142, and the following Example.

	12	
	12	
	—	
	24	
	12	
	—	
	144	
	12	
	—	
	288	
(N ^o . 189.)	144	
	—	
	1728	Inches in a Cube Foot
	.7857142	Given Decimal
	—	
	3456	
	6912	
	1728	
	12096	
	8640	
	13824	
	12096	
	—	
	1357.7141376	Content required

To know the Content of a Globe, whose Diameter is 12 Inches, by a given Decimal. See (N^o. 188.) for the Decimal.

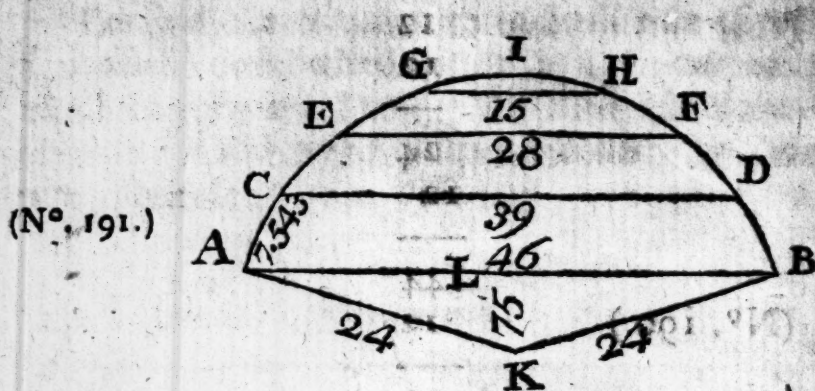
ARITHMETICK, &c. Improv'd. 137



$$\begin{array}{r}
 12 \\
 12 \\
 \hline
 24 \\
 12 \\
 \hline
 144 \\
 (N^o. 190.) \quad 12 \\
 \hline
 288 \\
 144 \\
 \hline
 1728 \quad \text{Inches in a Cube Foot} \\
 .5238094 \\
 \hline
 6912 \\
 15552 \\
 0000 \\
 13824 \\
 5184 \\
 3456 \\
 8640 \\
 \hline
 905.1426432 \quad \text{Content}
 \end{array}$$

To find the solid Content of the Frustum of a Globe. See AIB in (N^o. 191.) and observe that ABK is no Part of the Frustum; but is drawn in the Example to represent the Center, and compleat the Pyramids.

T (N^o. 191.)



First, Find the superficial Content of the Face, which is already done in (N^o. 148.) then consider a Globe contains an infinite Number of Pyramids pointing to the Center, of which the superficial Face is the Base, and AK, IK and BK is the Altitude. Look in (N^o. 148.) which gives the superficial Face of the Frustum (N^o. 146.) equal to (N^o. 191.) whose Content is 2495.07354, which multiply by $\frac{1}{3}$ of the Altitude AK, IK or BK, the Product is the Solid Content of AIBK, from which subtract the Cone ABK; the Remainder is the solid Content of the Frustum AIB. See the following Examples

(N ^o . 192.)	2495.07354	Superficial Face
	8	One 3d of Altitude AK, &c.
	19960.58832	Solid Content of AIBK
	4156.3875	Solid Content of ABK
	15804.20082	Solid Content required

Now

ARITHMETICK, &c. Improv'd. 139

Now find the fold Content of the Cone ABK.

$$7 = 22 = 46$$

$$\frac{22}{7}$$

$$92$$

$$\frac{92}{7}$$

7) 1012 (144.57 Circumf. of AB

$$7 \cdot$$

$$31$$

$$28$$

$$32$$

$$28$$

$$40$$

Add a Cypher

$$35$$

$$50$$

Add a Cypher

$$49$$

$$1$$

$$144.57$$

Circumference

$$11.5$$

One 4th of Diameter

$$722.85$$

$$1445.7$$

$$14457$$

$$1662.555$$

Content of Base or Circle AB

$$2.5$$

One 3d of Altitude KL

$$8312775$$

$$3325110$$

$$4156.3875$$

Solid Content of Cone ABK

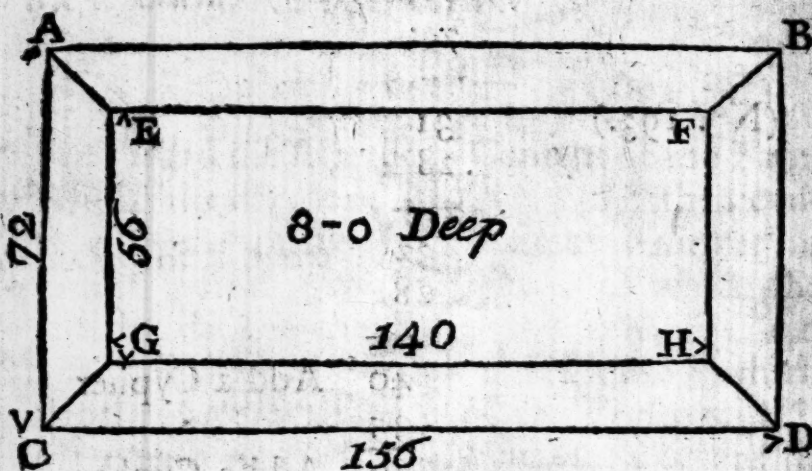
$$T \ 2$$

$$To$$

140 ARITHMETICK, &c. Improv'd.

To find the Content in Cube Yards of a Ba-
 son for Water, whose Form is the Frustum of
 an oblong Pyramid. See the Rule laid down in
 (N^o. 169 and 175.) and the following Exam-
 ple.

(N^o. 195.)



140 GH
 78 Half CD

—
 218 Sum
 56 GE

—
 1308
 1090

—
 12208 Product

156

ARITHMETICK, &c. Improv'd. 141

To know the Content of a
 Cone, or of a Solid of the
 same Figure, as a Cone, or
 a Solid of the same Figure,
 multiply the Area of the
 Base by the Height, and
 divide the Product by 3.
 The Quotient will be the
 Content.

452
 1582

(N^o. 196.)

16272

Product

12208

Product

28480

2.66

One 3d of Depth or Altitude

170880

170880

56960

Feet in a Cube Yd. 27) 75756.80 (2805.8 Content required

54

217

216

156

135

218

216

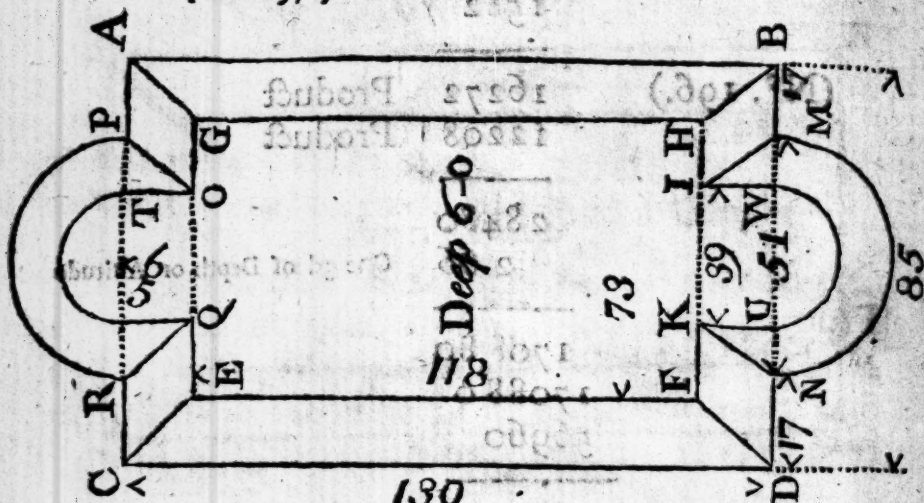
2

To

142 ARITHMETICK, &c. Improv'd.

To know the Content in Cube Yards of a
 Bason for Water, whose Form contains the
 Frustum of an Oblong Pyramid ; also, the
 Frustum of a Cone and two Right-angled Tri-
 angles. See (N^o. 197.) and the following Ex-
 amples.

(N^o. 197.)



See the three foregoing Examples, and by
 the same Rule begin to measure the Frustum of
 the Oblong Pyramid ABCDEFGH.

118	EF
65	Half CD
—	
183	Sum
73	HF
—	
549	
1281	
—	
13359	Product

130

ARITHMETICK, &c. Improved. 143

$$MM_{1302} = CD = 7$$

$$59^{\circ} \text{ Half EF}$$

$$18901 \text{ Sum}$$

$$8500 \text{ DB}$$

$$945$$

(N^o. 198.)

$$1512$$

$$16065 \text{ Product}$$

$$13359$$

$$29424 \text{ Sum}$$

$$2 \text{ One 3d of Depth or Altitude}$$

$$58848 \text{ Solid Cont. of Frustrum ABCDEFGH}$$

The two Semi-Circles at each End makes the Frustrum of a Cone, whose larger Diameter M N is 51, and lesser Diameter U W, &c. is 39; find their Circumferences and Areas, and proceed as is laid down in (N^o. 171 or 174.)

$$7 = 22 = 39 \text{ IK}$$

$$22$$

$$78$$

$$78$$

$$7)858(122.57 \text{ Circumference}$$

$$7$$

$$15$$

$$14$$

$$18$$

$$14$$

$$40 \text{ Add a Cypher}$$

$$35$$

$$50 \text{ Add a Cypher}$$

$$49$$

$$1$$

7

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$$7 = 22 = 51 \quad MN$$

(N^o. 199.)

$$7)1122(160.28 \quad \text{Circumference}$$

7

42

42

020 Add a Cypher

14

60 Add a Cypher

56

4

160.28 Circumference MN

12.75 One 4th of Diameter MN

801 40

112196

32056

16028

2043.5700 Area of Circle MN

122.57

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122.57 Circumference IK
 9.75 One 4th of Diameter IK
612 85

(N^o.200.) 85799

110313

1195.0575 Area of Circle IK

2043.57 Area MN.

83654025

59752875

35851725

47802300

239011500

1)2442183.655275(1562.748

1

25)144

125

306)1921

1836

3122)8583

6244

31247)233965

218729

312544)1523652

1250176

3125488)27347675

25003904

2343771

Root

Area IK

Area MN

4801.3755

2

One 3d of Depth or
Altitude

9602.7510

Solid Content of
Frustum MNRP

U

There

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There still remains unmeasured, two solid Right Angles, as KNU MIW RQS and POT equal to 6 Base and 6 Altitude, both which added together makes a square solid Body or Parallelopipedon, whose Sides are 6 and its Length is 39 for the Diameter KI, &c. and $\frac{2}{3}$ of the Slope WM, which is equal to 4, because each end is a Pyramid of 6 Altitude; so the Length in solid Measure is 43, which multiply by the Area of the two Sides, the Product is its Content.

	6	Side
	6	Side
(N ^o . 201.)	36	
	43	
	108	
	144	
	1548	Content of the two Right Angle Solids between the two Frustums
	58848	Content of Frustum ABCDEFGH
	9602.751	Content of Frustum MNR P
	69998.751	The solid Content required

The

The Use of an Instrument called a TANGENT RULE, for the taking any given Distance within a Quarter of a Mile.

SUPPOSE the Object to be cross a River or the like. FIG. 1. Represents the Face of the Instrument, and FIG. 2. is the perspective Elevation, BD is 6 Feet 8 Inches Long divided into 16000 equal Parts, by the Help of a half Inch diagonal Scale, of which FIG. 3. represents 6000 drawn to its full Proportion. The Distance between the Center C and the lower Line of the Scale at D, is five Links of Gunter's Chain equal to 39 Inches, and $\frac{1}{16}$, the Blade of the Square F must extend precisely to that Line (as in the Example) in order to bring down the Divisions to its Intersection, by the Index BL, as at M.

N.B. There is no Need to divide by the Scale any more than 6000 from D, (as FIG. 3.) because all the other Parts answer to Objects within Reach of a 10 Foot Pole; but the large Divisions of Thousands must be carefully divided on the whole Length between B and D; and observe, the 60 small Divisions on FIG. 1. as from D, are so many Hundreds, the Scale of this Draught being too small to set on the Sub-divisions; but they are represented by FIG. 3.

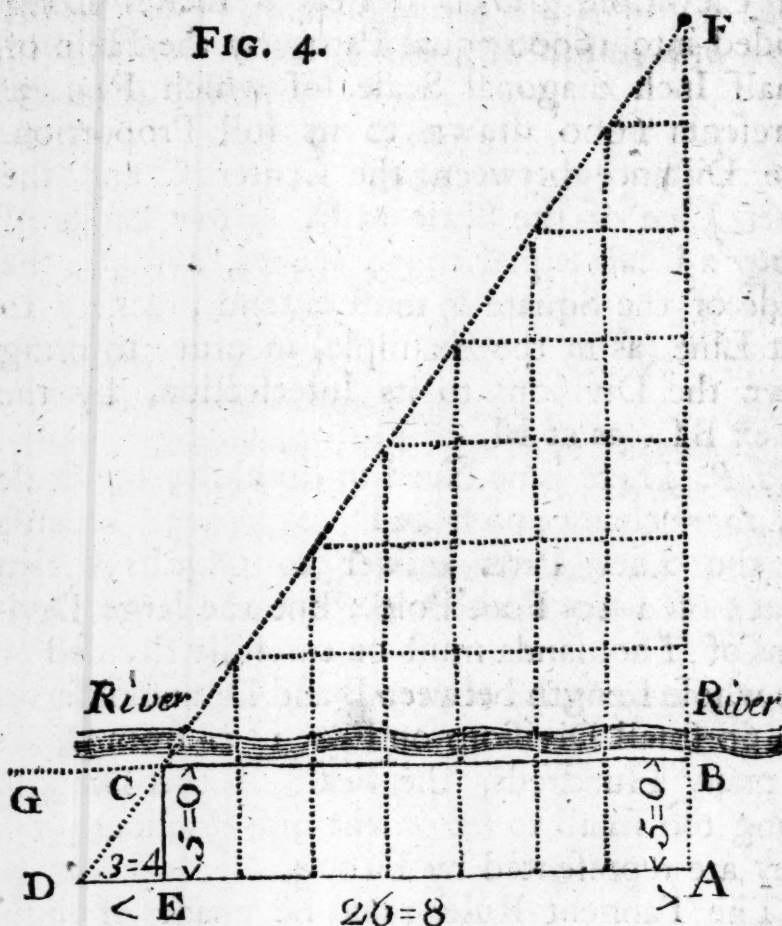
The Tangent Rule may be made of light Wood, and fixed to the Index of the Theodolite, so that it may be taken off or set on as Occasion requires, and fastened by Screws at A and B, at the Discretion of the Instrument-Maker. The only Person of that Trade, to which

I have demonstrated this Instrument, is Mr. *John Bennett*, at the *Globe* in *Crown-Court* near *Golden-Square*, *St. James's*.

Of the TABLES.

They are calculated from this simple mathematical Principle. See FIG. 4.

FIG. 4.



The Distance from A to F is required, without crossing the River; fet a Staff up at A and another as at B in a Line with AF, from whence raise a Perpendicular to D, draw BG of a Length

Length at Pleasure parallel to AD; then set up a Staff at D and another as at C on the Line GB in a direct Line with DF, draw a Line from C to the Line AD parallel with AB as CE, the Length AB or EC are 5 Feet, measure DE which proves to be 3 Feet 4 Inches; then does every 3 Feet 4 Inches on the Line AD produce 5 Feet to the Object F on the Line AF, and where there is a Remainder, it bears the same Proportion as EC is to DC, the Line AD is 26 Feet 8 Inches, which contains 8 Times the Space ED, and proves the Distance AF to be 8 Times 5 Feet equal to 40.

As AD, FIG. 4. is divided into 8 Parts, BD FIG. 1. which represents the same Line, is divided into 16000 Parts; again, as AB FIG. 4. is 5 Feet, CD FIG. 1. which represents the same Line is 5 Links, so I calculated my Numbers by Division and Multiplication, beginning at Number 40, and so on to Number 5328, because those under 40, not only run too far for the Object to be precisely distinguish'd; but cause the Angle to be so acute, that it cannot so well be depended on, and those above 5328 bring the Angle near enough to be measured by a 10 Foot Rod. And observe, at Number 700 I drop every other Number to 1000, and from thence to 2000; I have calculated but every 4th Number, and from 2000 to 4000 only every 8th Number, and from 4000 to the End of the Table, every 16th Number, because the Difference is small decimal Parts, and would swell the Tables to an unnecessary Size.

To

150 ARITHMETICK, &c. Improv'd.

To find a Distance, move the Instrument about till the Index GH or AB cuts the Object, continue it in the same Position, and move the Index IK or CEL till it also cuts the Object; then see what Division the Index cuts as at M, which suppose to be 3056. Look in the Table for that Number, and you will find against it 26 Links, and $\frac{17}{100}$ of a Link, which is the Distance; again, suppose the Index to cut 90 on the Instrument, look for Number 90 in the Table, and you will find against it 888 Links; again, if it cuts 40 you will find against it 2000 Links, which is equal to a Quarter of a Mile, and so of all other Numbers.

N.B. If the Index cuts on any of the Numbers which are left out, look in the Tables for the Number nearest to it, and take the Distance from the Length against that Number, the Difference from Truth will be only the small decimal Part of a Link.

Distance in LINKS.

N ^o .	Links	N ^o .	Links	N ^o .	Links
40	2000	49	1632	58	1379
41	1951	50	1600	59	1355
42	1904	51	1568	60	1333
43	1860	52	1538	61	1309
44	1818	53	1509	62	1290
45	1777	54	1481	63	1269
46	1739	55	1454	64	1277
47	1702	56	1428	65	1230
48	1666	57	1403	66	1212



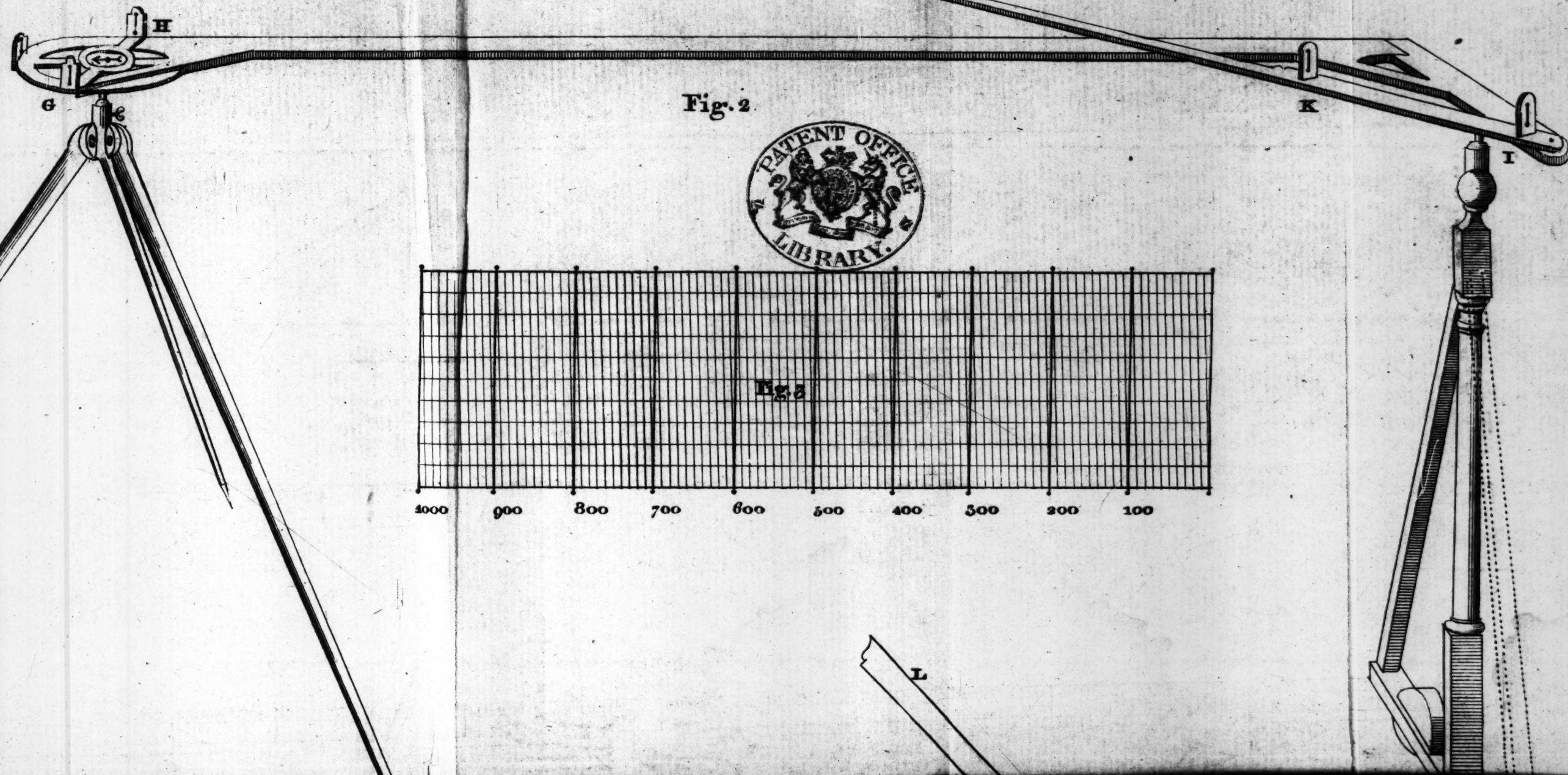
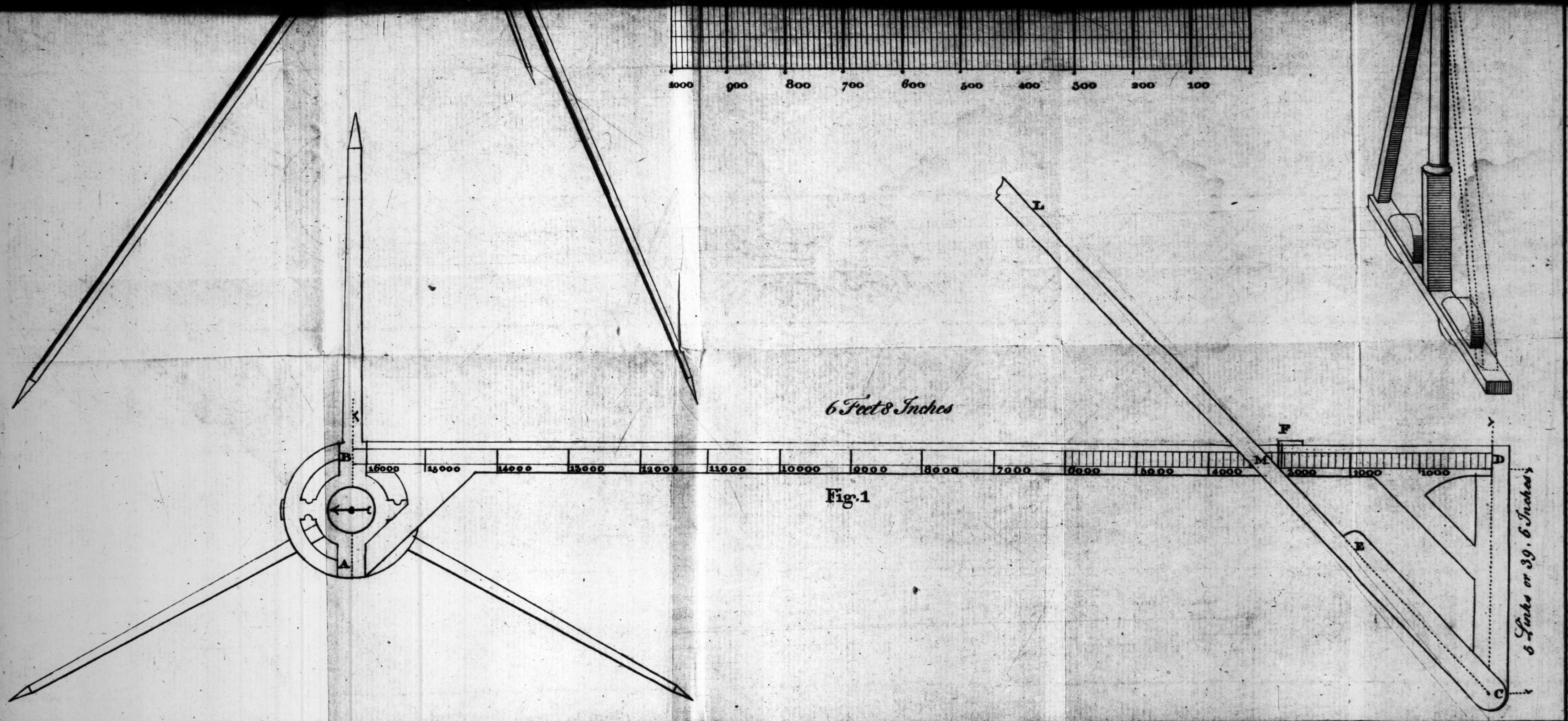


Fig. 2



Fig. 2



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N ^o .	Links	N ^o .	Links	N ^o .	Links
67	1194	100	800	133	601.5
68	1176	101	792	134	597
69	1159	102	784.3	135	592.5
70	1142	103	776.7	136	588.2
71	1126	104	769.2	137	583.5
72	1111	105	761.9	138	579.6
73	1095	106	754.7	139	575.5
74	1081	107	747.6	140	571.4
75	1066	108	740.7	141	567.3
76	1052	109	733.9	142	563.3
77	1039	110	727.25	143	559
78	1025	111	720.7	144	555.5
79	1012	112	714.25	145	551.7
80	1000	113	707.9	146	547.9
81	987	114	701.75	147	543.8
82	975	115	695.5	148	540.5
83	963	116	689.6	149	536.5
84	952	117	683.75	150	533.3
85	941	118	677.9	151	529.8
86	930	119	672.25	152	526.3
87	919	120	666	153	522.8
88	909	121	661.1	154	519.4
89	898	122	654.9	155	516.1
90	888	123	650	156	512.8
91	879	124	645	157	509.5
92	869	125	640	158	506.3
93	860	126	635	159	503.1
94	851	127	629.9	160	500
95	842	128	625	161	496.9
96	833	129	620	162	493.8
97	824	130	615	163	490.8
98	816	131	610.7	164	487.8
99	808	132	606	165	484.8

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N ^o .	Links	N ^o .	Links	N ^o .	Links
166	481.9	199	402	232	344.8
167	478.9	200	400	233	343.3
168	476.2	201	398	234	341.9
169	473	202	396	235	340
170	470.5	203	394	236	338.9
171	467.8	204	392.1	237	337.5
172	465	205	390	238	336.1
173	462.4	206	388.3	239	334.7
174	459.75	207	386.4	240	333.3
175	457.1	208	384.6	241	331.9
176	454.5	209	382.5	242	330.5
177	451.9	210	380.9	243	329.2
178	449.4	211	379.1	244	327.5
179	446.6	212	377.3	245	326.3
180	444.4	213	375.5	246	325
181	441.9	214	373.8	247	323.8
182	439.5	215	372	248	322.5
183	436.8	216	370.3	249	321.25
184	434.75	217	368.6	250	320
185	432.4	218	366.9	251	318.75
186	430	219	365.3	252	317.5
187	427.75	220	363.6	253	316.2
188	425.5	221	361.75	254	314.9
189	423.25	222	360.3	255	313.7
190	421	223	358.75	256	312.5
191	418.8	224	357.1	257	311
192	416.4	225	355.5	258	310.2
193	414.5	226	353.9	259	308.8
194	412.3	227	352.4	260	307.5
195	410	228	350.9	261	306.5
196	408.1	229	349.3	262	305.3
197	406	230	347.7	263	304.1
198	404	231	346.3	264	303

ARITHMETICK, &c. Improv'd. 153

N ^o .	Links	N ^o .	Links	N ^o .	Links
265	301.9	298	268.25	331	241.7
266	300.7	299	267.55	332	240.95
267	299.6	300	266.4	333	240
268	298.5	301	265.6	334	239.45
269	297.2	302	264.9	335	238.8
270	296	303	264	336	238.1
271	295	304	263.15	337	237.35
272	294.1	305	262.3	338	236.5
273	293	306	261.4	339	236
274	291.8	307	260.6	340	235.25
275	290.2	308	259.7	341	234.6
276	289.8	309	258.9	342	233.9
277	288.8	310	258	343	233.2
278	287.75	311	257.25	344	232.5
279	286.75	312	256.4	345	231.9
280	285.7	313	255.6	346	231.2
281	284.7	314	254.75	347	230.5
282	283.65	315	254	348	229.8
283	282.7	316	253.1	349	229.2
284	281.65	317	252.3	350	228.5
285	280.5	318	251.6	351	227.9
286	279.5	319	250.75	352	227.25
287	278.75	320	250	353	226.6
288	277.75	321	249.4	354	225.95
289	276.8	322	248.45	355	225.35
290	275.85	323	247.65	356	224.7
291	274.75	324	246.9	357	224.1
292	273.95	325	246.1	358	223.3
293	273	326	245.4	359	223.8
294	271.9	327	244.6	360	222.2
295	271.2	328	243.9	361	221.6
296	270.25	329	243.1	362	220.95
297	269.35	330	242.4	363	220.35

X

364

154 ARITHMETICK, &c. Improv'd.

N ^o .	Links	N ^o .	Links	N ^o .	Links
364	219.75	397	201.5	430	186
365	219.15	398	201	431	185.6
366	218.4	399	200.5	432	185.15
367	217.95	400	200	433	184.75
368	217.37	401	199.5	434	184.3
369	216.8	402	199	435	183.9
370	216.2	403	198.5	436	183.45
371	215.6	404	198	437	183
372	215	405	197.5	438	182.65
373	214.45	406	197	439	182.2
374	213.62	407	196.56	440	181.8
375	213.3	408	196	441	181.4
376	212.75	409	196.5	442	180.87
377	212.2	410	195	443	180.5
378	211.6	411	194.6	444	180.15
379	211.1	412	194.15	445	179.75
380	210.5	413	193.7	446	179.37
381	210	414	193.2	447	178.85
382	209.4	415	192.75	448	178.55
383	208.9	416	192.3	449	178.15
384	208.2	417	191.85	450	177.75
385	207.8	418	191.25	451	177.4
386	207.25	419	190.9	452	176.95
387	206.7	420	190.45	453	176.6
388	206.15	421	190	454	176.2
389	205.65	422	189.55	455	175.8
390	205	423	189.1	456	175.45
391	204.6	424	188.65	457	175
392	204	425	188.25	458	174.55
393	203.55	426	187.75	459	174.3
394	203	427	187.25	460	173.85
395	202.5	428	186.9	461	173.55
396	202	429	186.3	462	173.15

ARITHMETICK, &c. Improv'd. 155

N ^o .	Links	N ^o .	Links	N ^o .	Links
463	172.8	496	161.25	529	151.25
464	172.4	497	161	530	150.95
465	172	498	160.64	531	150.65
466	171.65	499	160.3	532	150.35
467	171.3	500	160	533	150.1
468	170.95	501	159.6	534	149.8
469	170.55	502	159.37	535	149.5
470	170.2	503	159	536	149.25
471	169.85	504	158.75	537	148.95
472	169.45	505	158.4	538	148.6
473	169.1	506	158.1	539	148.3
474	168.75	507	157.8	540	148
475	168.4	508	157.45	541	147.75
476	168.06	509	157.15	542	147.5
477	167.6	510	156.85	543	147.25
478	167.35	511	156.5	544	147
479	167	512	156.25	545	146.75
480	166.66	513	155.9	546	146.5
481	166.3	514	155.5	547	146.25
482	165.95	515	155.3	548	145.8
483	165.6	516	155	549	145.6
484	165.25	517	154.75	550	145.4
485	164.95	518	154.4	551	145.15
486	164.6	519	154.1	552	144.8
487	164.27	520	153.75	553	144.65
488	163.75	521	153.5	554	144.4
489	163.6	522	153.25	555	144.15
490	163.15	523	152.95	556	143.87
491	162.9	524	152.65	557	143.6
492	162.5	525	152.4	558	143.37
493	162.25	526	152	559	143.1
494	161.9	527	151.8	560	142.85
495	161.5	528	151.5	561	142.6

156 ARITHMETICK, &c. Improv'd.

N ^o .	Links	N ^o .	Links	N ^o .	Links
562	142.35	595	134.35	628	127.4
563	142.1	596	134.12	629	127.2
564	141.82	597	134	630	127
565	141.6	598	133.77	631	126.8
566	141.35	599	133.55	632	126.55
567	141.1	600	133.3	633	126.35
568	140.82	601	133.1	634	126.15
569	140.6	602	132.8	635	125.95
570	140.35	603	132.65	636	125.8
571	140.1	604	132.45	637	125.55
572	139.75	605	132.2	638	125.37
573	139.6	606	132	639	125.2
574	139.37	607	131.8	640	125
575	139.1	608	131.57	641	124.8
576	138.87	609	131.3	642	124.6
577	138.65	610	131.15	643	124.4
578	138.4	611	130.9	644	124.22
579	138.15	612	130.7	645	124
580	137.92	613	130.5	646	123.82
581	137.7	614	130.3	647	123.65
582	137.37	615	130.05	648	123.45
583	137.2	616	129.85	649	123.25
584	136.97	617	129.65	650	123.07
585	136.75	618	129.45	651	122.9
586	136.5	619	129.25	652	122.7
587	136.3	620	129	653	122.5
588	135.95	621	128.8	654	122.3
589	135.8	622	128.62	655	122.13
590	135.6	623	128.4	656	121.95
591	135.35	624	128.2	657	121.75
592	135.12	625	128	658	121.55
593	134.9	626	127.8	659	121.4
594	134.67	627	127.6	660	121.2

ARITHMETICK, &c. Improv'd. 137

N ^o .	Links	N ^o .	Links	N ^o .	Links
661	121	694	115.25	754	106.1
662	120.85	695	115.1	756	105.92
663	120.63	696	114.94	758	105.55
664	120.47	697	114.77	760	105.25
665	120.3	698	114.6	762	105
666	120.1	699	114.44	764	104.71
667	119.9	700	114.25	766	104.45
668	119.72	702	113.95	768	104.16
669	119.55	704	113.62	770	103.9
670	119.4	706	113.3	772	103.64
671	119.25	708	112.97	774	103.35
672	119.05	710	112.67	776	103.07
673	118.85	712	112.35	778	102.82
674	118.67	714	112.05	780	102.5
675	118.51	716	111.73	782	102.3
676	118.25	718	111.42	784	102
677	118.16	720	111.11	786	101.77
678	118	722	110.8	788	101.5
679	117.82	724	110.49	790	101.25
680	117.64	726	110.17	792	101
681	117.47	728	109.94	794	100.75
682	117.3	730	109.58	796	100.5
683	117.13	732	109.2	798	100.25
684	116.95	734	108.97	800	100
685	116.78	736	108.67	802	99.7
686	116.6	738	108.4	804	99.5
687	116.44	740	108.1	806	99.25
688	116.25	742	107.8	808	99
689	116.11	744	107.5	810	98.75
690	115.95	746	107.22	812	98.5
691	115.77	748	106.82	814	98.28
692	115.6	750	106.65	816	98
693	115.44	752	106.37	818	97.79

Y38 ARITHMETICK, &c. Improv'd.

N ^o .	Links	N ^o .	Links	N ^o .	Links
820	97.5	886	90.25	952	84.03
822	97.3	888	90.07	954	83.8
824	97.07	890	89.87	956	83.67
826	96.85	892	89.68	958	83.5
828	96.6	894	89.42	960	83.33
830	96.37	896	89.27	962	83.15
832	96.15	898	89.07	964	82.97
834	95.92	900	88.87	966	82.8
836	95.62	902	88.7	968	82.62
838	95.45	904	88.47	970	82.42
840	95.22	906	88.3	972	82.3
842	95	908	88.1	974	82.13
844	94.77	910	87.9	976	81.87
846	94.55	912	87.72	978	81.79
848	94.32	914	87.5	980	81.57
850	94.12	916	87.27	982	81.45
852	93.87	918	87.15	984	81.25
854	93.62	920	86.92	986	81.12
856	93.45	922	86.77	988	80.95
858	93.24	924	86.57	990	80.75
860	93	926	86.4	992	80.62
862	92.8	928	86.2	994	80.5
864	92.57	930	86.	996	80.32
866	92.37	932	85.82	998	80.15
868	92.15	934	85.63	1000	80
870	91.95	936	85.47	1004	79.68
872	91.72	938	85.27	1008	79.37
874	91.5	940	85.1	1012	79.05
876	91.32	942	84.92	1016	78.72
878	91.1	944	84.72	1020	78.42
880	90.9	946	84.55	1024	78.12
882	90.7	948	84.37	1028	77.75
884	90.43	950	84.2	1032	77.5

ARITHMETICK, &c. Improv'd. 159

N ^o .	Links	N ^o .	Links	N ^o .	Links
1036	77.2	1168	68.48	1300	61.53
1040	76.87	1172	68.25	1304	61.35
1044	76.62	1176	67.97	1308	61.15
1048	76.32	1180	67.8	1312	60.97
1052	76	1184	67.56	1316	60.77
1056	75.75	1188	67.33	1320	60.6
1060	75.47	1192	67.06	1324	60.42
1064	75.17	1196	66.88	1328	60.23
1068	74.9	1200	66.65	1332	60.05
1072	74.62	1204	66.4	1336	59.86
1076	74.3	1208	66.22	1340	59.7
1080	74	1212	66	1344	59.52
1084	73.75	1216	65.78	1348	59.33
1088	73.5	1220	65.57	1352	59.12
1092	73.25	1224	65.35	1356	59
1096	72.9	1228	65.15	1360	58.82
1100	72.7	1232	64.92	1364	58.65
1104	72.4	1236	64.72	1368	58.47
1108	72.2	1240	64.5	1372	58.3
1112	71.93	1244	64.31	1376	58.12
1116	71.68	1248	64.1	1380	57.97
1120	71.42	1252	63.9	1384	57.8
1124	71.17	1256	63.7	1388	57.62
1128	70.91	1260	63.5	1392	57.42
1132	70.67	1264	63.27	1396	57.2
1136	70.41	1268	63.07	1400	57.02
1140	70.12	1272	62.9	1404	56.97
1144	69.87	1276	62.68	1408	56.81
1148	69.67	1280	62.5	1412	56.65
1152	69.43	1284	62.3	1416	56.48
1156	69.2	1288	62.11	1420	56.33
1160	68.96	1292	61.91	1424	56.17
1164	68.68	1296	61.72	1428	56.02

160 ARITHMETICK, &c. Improv'd.

N ^o .	Links	N ^o .	Links	N ^o .	Links
1432	55.86	1564	51.15	1696	47.16
1436	55.71	1568	51	1700	47.06
1440	55.55	1572	50.88	1704	46.93
1444	55.4	1576	50.75	1708	46.81
1448	55.24	1580	50.62	1712	46.72
1452	55.8	1584	50.5	1716	46.62
1456	54.97	1588	50.37	1720	46.5
1460	54.79	1592	50.25	1724	46.4
1464	54.6	1596	50.12	1728	46.28
1468	54.48	1600	50	1732	46.18
1472	54.33	1604	49.87	1736	46.07
1476	54.2	1608	49.75	1740	45.97
1480	54.05	1612	49.62	1744	45.86
1484	53.9	1616	49.5	1748	45.75
1488	53.75	1620	49.37	1752	45.66
1492	53.61	1624	49.25	1756	45.55
1496	53.41	1628	49.14	1760	45.45
1500	53.32	1632	49	1764	45.35
1504	53.18	1636	48.89	1768	45.21
1508	53.05	1640	48.75	1772	45.12
1512	52.96	1644	48.65	1776	45.03
1516	52.77	1648	48.53	1780	44.93
1520	52.62	1652	48.42	1784	44.84
1524	52.5	1656	48.3	1788	44.71
1528	52.35	1660	48.18	1792	44.63
1532	52.22	1664	48.07	1796	44.53
1536	52.08	1668	47.96	1800	44.43
1540	51.95	1672	47.81	1804	44.35
1544	51.82	1676	47.72	1808	44.23
1548	51.67	1680	47.61	1812	44.15
1552	51.53	1684	47.5	1816	44.05
1556	51.41	1688	47.38	1820	43.95
1560	51.25	1692	47.27	1824	43.86

ARITHMETICK, &c. Improv'd. 161

N ^o .	Links	N ^o .	Links	N ^o .	Links
1828	43.75	1960	40.78	2184	36.62
1832	43.63	1964	40.72	2192	36.45
1836	43.57	1968	40.62	2200	36.35
1840	43.46	1972	40.56	2208	36.2
1844	43.38	1976	40.47	2216	36.1
1848	43.28	1980	40.38	2224	35.96
1852	43.2	1984	40.31	2232	35.84
1856	43.1	1988	40.25	2240	35.71
1860	43	1992	40.16	2248	35.58
1864	42.91	1996	40.07	2256	35.45
1868	42.81	2000	40	2264	35.33
1872	42.73	2008	39.84	2272	35.2
1876	42.63	2016	39.68	2280	35.06
1880	42.55	2024	39.52	2288	34.93
1884	42.46	2032	39.36	2296	34.83
1888	42.36	2040	39.21	2304	34.71
1892	42.27	2048	39.06	2312	34.6
1896	42.18	2056	38.87	2320	34.48
1900	42.1	2064	38.75	2328	34.34
1904	42	2072	38.6	2336	34.24
1908	41.9	2080	38.43	2344	34.12
1912	41.83	2088	38.31	2352	33.98
1916	41.75	2096	38.16	2360	33.9
1920	41.66	2104	38	2368	33.78
1924	41.57	2112	37.87	2376	33.66
1928	41.48	2120	37.73	2384	33.53
1932	41.4	2128	37.58	2392	33.44
1936	41.31	2136	37.45	2400	33.32
1940	41.21	2144	37.31	2408	33.2
1944	41.15	2152	37.15	2416	33.11
1948	41.06	2160	37	2424	33
1952	40.93	2168	36.87	2432	32.89
1956	40.89	2176	36.75	2440	32.78

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2448

162. ARITHMETICK, &c. Improv'd.

N ^o .	Links	N ^o .	Links	N ^o .	Links
2448	32.67	2712	29.5	2976	26.87
2456	32.57	2720	29.41	2984	26.8
2464	32.46	2728	29.32	2992	26.7
2472	32.36	2736	29.23	3000	26.66
2480	32.25	2744	29.15	3008	26.59
2488	32.15	2752	29.06	3016	26.52
2496	32.05	2760	28.98	3024	26.48
2504	31.95	2768	28.9	3032	26.38
2512	31.85	2776	28.81	3040	26.31
2520	31.75	2784	28.73	3048	26.25
2528	31.63	2792	28.65	3056	26.17
2536	31.53	2800	28.56	3064	26.11
2544	31.45	2808	28.48	3072	26.04
2552	31.34	2816	28.4	3080	25.97
2560	31.25	2824	28.32	3088	25.91
2568	31.15	2832	28.24	3096	25.83
2576	31.05	2840	28.16	3104	25.76
2584	30.95	2848	28.08	3112	25.70
2592	30.86	2856	28.01	3120	25.62
2600	30.76	2864	27.93	3128	25.57
2608	30.67	2872	27.85	3136	25.5
2616	30.57	2880	27.77	3144	25.44
2624	30.48	2888	27.7	3152	25.37
2632	30.38	2896	27.62	3160	25.31
2640	30.3	2904	27.54	3168	25.25
2648	30.21	2912	27.48	3176	25.18
2656	30.11	2920	27.39	3184	25.12
2664	30.02	2928	27.30	3192	25.06
2672	29.93	2936	27.24	3200	25
2680	29.85	2944	27.16	3208	24.93
2688	29.76	2952	27.1	3216	24.87
2696	29.66	2960	27.02	3224	24.81
2704	29.56	2968	26.95	3232	24.75

ARITHMETICK, &c. Improv'd. 163

N ^o .	Links	N ^o .	Links	N ^o .	Links
3240	24.68	2504	22.82	3768	21.23
3248	24.62	3512	22.77	3776	21.18
3256	24.57	3520	22.72	3784	21.13
3264	24.5	3528	22.67	3792	21.09
3272	24.44	3536	22.6	3800	21.05
3280	24.37	3544	22.56	3808	21
3288	24.32	3552	22.51	3816	20.95
3296	24.26	3560	22.46	3824	20.91
3304	24.21	3568	22.42	3832	20.87
3312	24.15	3576	22.35	3840	20.83
3320	24.09	3584	22.31	3848	20.78
3328	24.03	3592	22.26	3856	20.74
3336	23.98	3600	22.21	3864	20.7
3344	23.9	3608	22.17	3872	20.65
3352	23.86	3616	22.11	3880	20.6
3360	23.8	3624	22.07	3888	20.57
3368	23.75	3632	22.02	3896	20.53
3376	23.69	3640	21.97	3904	20.46
3384	23.63	3648	21.93	3912	20.44
3392	23.58	3656	21.87	3920	20.39
3400	23.53	3664	21.81	3928	20.35
3408	23.46	3672	21.78	3936	20.31
3416	23.4	3680	21.73	3944	20.28
3424	23.36	3688	21.69	3952	20.22
3432	23.31	3696	21.64	3960	20.19
3440	23.25	3704	21.6	3968	20.15
3448	23.2	3712	21.55	3976	20.12
3456	23.14	3720	21.5	3984	20.08
3464	23.09	3728	21.45	3992	20.04
3472	23.03	3736	21.40	4000	20
3580	22.98	3744	21.36	4016	19.92
3488	22.93	3752	21.31	4032	19.84
3496	22.87	3760	21.27	4048	19.76

164 ARITHMETICK, &c. Improv'd.

N ^o .	Links	N ^o .	Links	N ^o .	Links
4064	19.68	4496	17.79	4928	16.23
4080	19.60	4512	17.72	4944	16.18
4096	19.53	4528	17.66	4960	16.12
4112	19.43	4544	17.6	4976	16.07
4128	19.37	4560	17.53	4992	16.02
4144	19.3	4576	17.46	5008	15.97
4160	19.21	4592	17.41	5024	15.92
4176	19.15	4608	17.35	5040	15.87
4192	19.08	4624	17.3	5056	15.81
4208	19	4640	17.24	5072	15.76
4224	18.93	4656	17.17	5088	15.72
4240	18.86	4672	17.12	5104	15.67
4256	18.79	4688	17.06	5120	15.62
4272	18.72	4704	16.99	5136	15.57
4288	18.65	4720	16.95	5152	15.52
4304	18.57	4736	16.89	5168	15.47
4320	18.5	4752	16.83	5184	15.43
4336	18.43	4768	16.76	5200	15.38
4352	18.38	4784	16.72	5216	15.33
4368	18.31	4800	16.66	5232	15.28
4384	18.22	4816	16.6	5248	15.24
4400	18.17	4832	16.55	5264	15.19
4416	18.1	4848	16.5	5280	15.15
4432	18.05	4864	16.44	5296	15.1
4448	17.98	4880	16.39	5312	15.05
4464	17.92	4896	16.33	5328	15.01
4480	17.85	4912	16.28		

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